WIRE AND WIRE PRODUCTS

MARCH 1939

VAUGHN
WIRE DRAWING MACHINERY

. . . represents the accumulated results and experience of over 65 years of specialization in the design, manufacture and installation of equipment for drawing ferrous and non-ferrous metal wire of every description.

During 1939,—whether you are considering new equipment or replacement,—there is a machine in the Vaughn line to meet your requirements. Many problems will present themselves. You will find it profitable to discuss them with us.

THE VAUGHN MACHINERY COMPANY
CUYAHOGA FALLS, OHIO

VAUGHN WIRE DRAWING EQUIPMENT:
Complete Wire Drawing Equipment . . . Continuous or Single Hole . . . for the Largest Bars . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys.

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

Marching along together

STEEL.. STYLE.... COMFORT

Except for *steel*, the shoes we wear would be little better than medieval sandals, with their shapeless ugliness and destruction of foot health.

The arch which assures comfort, safety, lasting appearance, is made by a steel brace concealed in the leather. Heels are possible because of steel nails. Steel eyelets keep the laces from tearing the leather. The laces thread easily because of steel tips--to say nothing of the steel machinery vital to processing the leather and making the shoes themselves.

It takes almost 100 pieces of steel to make most pairs of modern shoes, and they are only a small fraction of the thousands and thousands of pieces of steel you use every day to make life comfortable and safe. Steel makes possible your electric light, home heating plant, canned food delicacies, automobile, office building and factory, railroad--in fact steel makes possible the standard of living on which civilization depends.

For almost every one of this multitude of uses a special steel is required, and Youngstown maintains a great laboratory and special staffs of research and field experts to find exactly the right steel for every modern use.

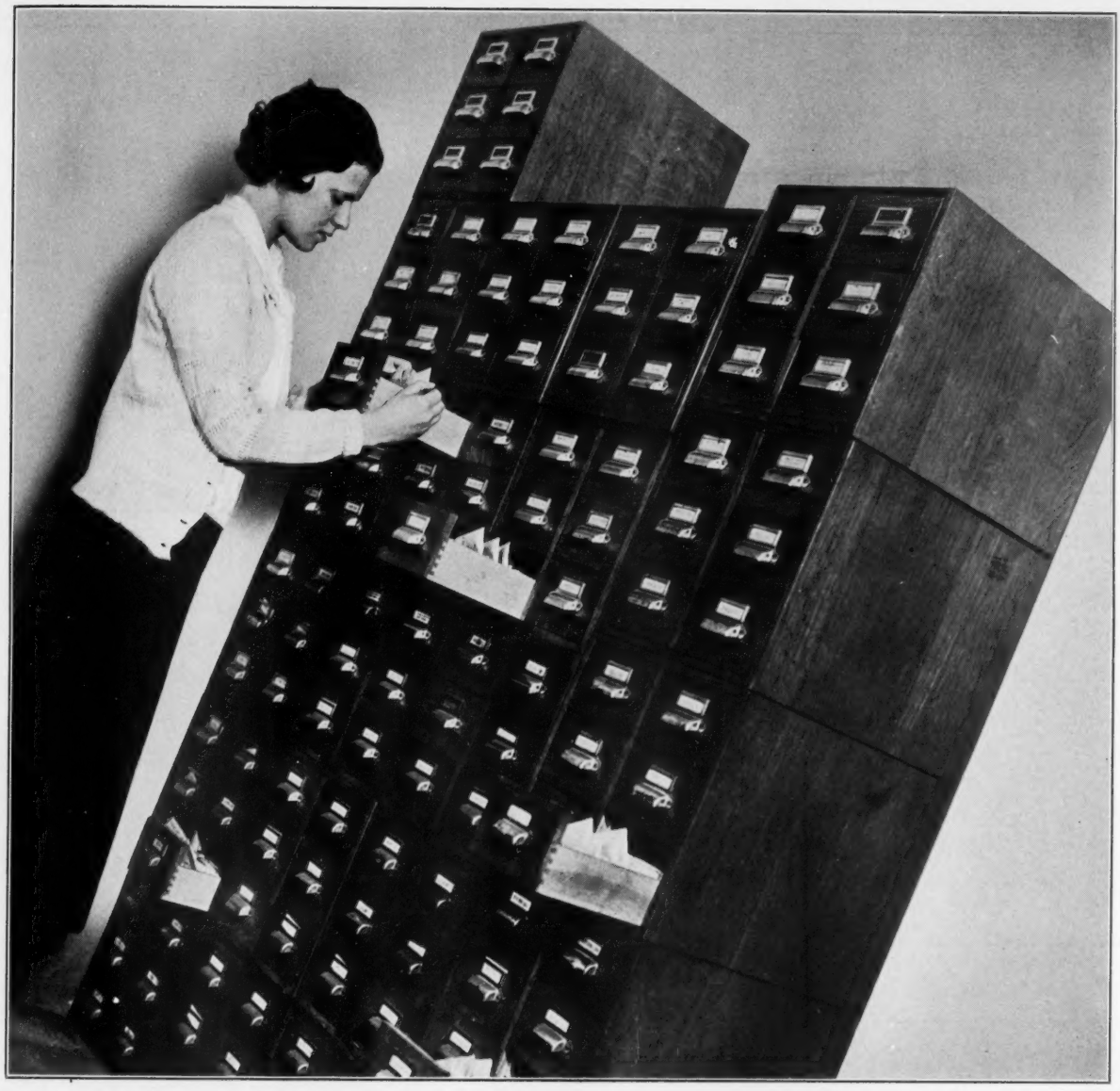
QUALITY TRADE MARK YOUNGSTOWN SERVICE

Sheets - Plates - Pipe and Tubular Products - Conduit - Tin Plate - Bars Rods - Wire - Nails - Unions - Tie Plates and Spikes

25-11B

YOUNGSTOWN

THE YOUNGSTOWN SHEET AND TUBE COMPANY
Manufacturers of Carbon and Alloy Steels
General Offices
YOUNGSTOWN, OHIO



Half a Million Grams of Carboloy, NOT FOR SALE!

To give you a uniformly good product today — and a *better product tomorrow* — more than 500,000 grams of Carboloy have been accumulated in a permanent reference file by our metallurgists during the past 10 years.

From each test grade — and from each *regular production "batch"* of Carboloy — three small bars are withdrawn, given four tests for quality and then stored in this cemented carbide experimental and production file.

Today, tomorrow and for years to come, this file stands ready to provide the answer to problems that arise. It represents another check — another safeguard that has been set up to provide a reliable product today — and an improved product for the future.

CARBOLOY COMPANY, INC.
DETROIT, MICHIGAN
CHICAGO • CLEVELAND • NEWARK • PHILADELPHIA • PITTSBURGH • WORCESTER, MASS.

Authorized Distributors: **Hartley Wire Die Co., Waterbury, Conn. • Canadian General Electric Co., Ltd., Toronto, Canada**

The WORCESTER REGIONAL MEETING

OF THE

WIRE ASSOCIATION

WILL BE HELD AT WORCESTER, MASS.

Tuesday, April 25, 1939

✦ ✦ ✦ GENERAL PROGRAM ✦ ✦ ✦

Headquarters Will Be At The Hotel Bancroft.

1:30 P. M. Visit To Plant Of The Norton Company.

6:00 P. M. Informal Dinner At Hotel Bancroft.

▲▲▲

7:30 P. M. Wire Association Meeting.

Paper: "Trouble Shooting With Metallography"

By C. G. Johnson,
Assistant Professor of Mechanical Engineering,
Worcester Polytechnic Institute

Paper: "Applications of Norton Products in the Wire Industry"

Papers To Be Followed By Informal Discussions On Subjects Presented

— COMMITTEE IN CHARGE —

R. R. Tatnall, Metallurgist
Wickwire-Spencer Steel Co.
Worcester, Mass.

K. B. LEWIS,
Consulting Engineer,
Worcester, Mass.

R. V. OLSEN,
President,
Mossberg Pressed Steel Corp.,
Attleboro, Mass.

*P. A. BEAMAN,
Sales Manager,
Wire Machinery Div.,
Morgan Construction Co.,
Worcester, Mass.

S. EKSTROM,
Works Manager,
N. E. High Carbon Wire Co.,
Millbury, Mass.

EUGENE ROTH,
Manager,
The Carboloy Co., Inc.
Worcester, Mass.

EARLE H. THOMAS,
Superintendent,
George W. Prentiss Co.,
Holyoke, Mass.

All Wire Mill Men Are Invited To Attend This Meeting
Cards of Admission May Be Obtained From Members of
The Committee in Charge or From
Richard E. Brown, Secretary,
17 E. 42nd St., New York, N. Y.

QUALITY RIVETS

from the *Quality* WIRE

Plain Carbon or *Stainless*

The difficulties encountered in the manufacture of tubular rivets require wire of extraordinary properties—wire that will easily respond to severe cold work including upsetting operations that involve heading, intricate extrusion and, finally, rolling or setting the thin tubular wall during assembly. For many years "Pittsburgh" Tubular Rivet Wire has successfully met the rigid requirements of the industry. It comes to the rivet maker commercially free from surface imperfections such as scratches, seams, laps, segregations, etc. Thus it works through the various operations with uniform ease. "Pittsburgh" Tubular Rivet Wire and "Pittsburgh" engineering service provide double insurance against manufacturing grief. Write for full data and cost information.

PITTSBURGH STEEL COMPANY, 1641 GRANT BUILDING, PITTSBURGH, PA.

New York Detroit Chicago Cleveland Tulsa Houston Los Angeles

Pittsburgh Wire

ATTENTION!

Members of the Wire Association!

ON APRIL 5th, 1939

The National Industrial Preparedness Dinner

WILL BE HELD AT

THE WALDORF-ASTORIA HOTEL

NEW YORK, N. Y.

THE SPEAKER WILL BE

THE ASSISTANT SECRETARY OF WAR

COL. LOUIS JOHNSON

▲▲▲

PRECEDING THE DINNER

THE NEW YORK SIGNAL CORPS PROCUREMENT DISTRICT

WILL HOLD OPEN HOUSE ALL DAY AT THE SIGNAL SECTION,
NEW YORK GENERAL DEPOT

First Avenue and 58th Street,
Brooklyn, N. Y.

▲▲▲

ALL members of the Wire Association are invited to visit the Signal Corps Depot at the Army Base at Brooklyn on that date to inspect Signal Corps equipment, and make the acquaintance of the officers on duty there.

✦ ✦ ✦

FOR the convenience of members of the Wire Association reception rooms will be maintained at the Waldorf-Astoria Hotel, New York, all day.

✦ ✦ ✦

INFORMATION regarding invitations to attend the National Preparedness Dinner and for details regarding the visit to the Army Base in Brooklyn, may be obtained by addressing

RICHARD E. BROWN, SECRETARY
THE WIRE ASSOCIATION

17 EAST 42nd ST., NEW YORK, N. Y.

Meets Exacting Requirements

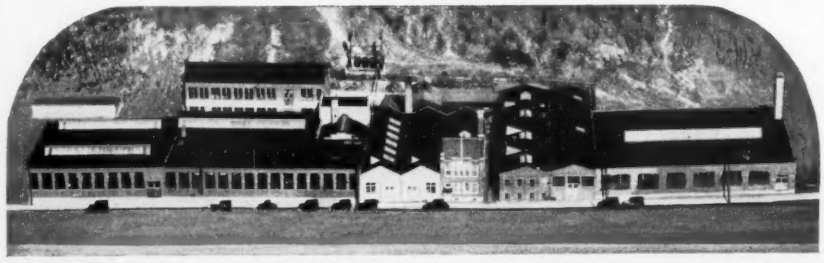
Winco

Leak-proof Enameled Wire

It is the copper we use that enables us to state without qualification that Winco Enameled Wire will not leak. We use special oxygen-free copper that draws so clean, so free from slivers, that the enameling is perfect. There's not a leak in it. Every spool of wire is mercury-tested before shipment to assure the buyer a wire as perfect as humans can make it. Write for a generous sample.

* * *

Winco Enameled wire is covered to the same dimensions as fabric-covered wire so the user need not change his equipment. It will withstand softening in varnish-dipping and baking. It costs considerably less than silk-covered wire. Write for sample.



HUDCO

Hudco Products cover a complete line of fine wires of all kinds, bare and for metal spraying. Also, brush wires of all kinds, tinsel lahns, metallic fibres for packing purposes, etc. Hudco is headquarters for supplies of this sort. Established in 1902, experience and skilled workmanship are back of every Hudco product.

HUDSON WIRE COMPANY

OSSINING, N. Y.

ESTAB. 1902 Successors ROYLE & AKIN ESTAB. 1902

SIMPLE ARITHMETIC

--And the proof is found in the Morrison FLASH Bakers that are doing this job every day.

You know what rod baking is costing you now. Then just make a guess at what the following could save you - - -

Eliminate your present room or department devoted to rod baking and substitute for this only one more unit in the cleaning line or circle. This tank-sized unit will process at least 80 pin loads of rod per shift without even removal of material from the hook.

Send rod to the drawing benches perfectly uniform throughout the coil; rod that will save time and trouble all along the line -- the best treated rod that ever went through the dies.

You know what this is worth to you. Remember, there is nothing un-tried or experimental involved in the process. Many leading mills are doing this today and have cut rod baking costs to a small fraction of former figures.

-- And what does all this? The Morrison Flash Baker. Let us tell you the rest of the story.

Morrison Flash Bakers protected by U. S. Patent No. 1,999,513.
Other patents pending. Trade Mark registered.

MORRISON ENGINEERING COMPANY, INC.

5005 EUCLID AVENUE CLEVELAND, OHIO

MORRISON ENGINEERED

IF IT'S A FLASH BAKER - MORRISON BUILT IT

WILSON
Wire Annealing
UNDER TWO FLAGS

MONTH by month the number of installations of the Wilson Cylindrical Bell Type Furnace in the wire industry continues to grow.

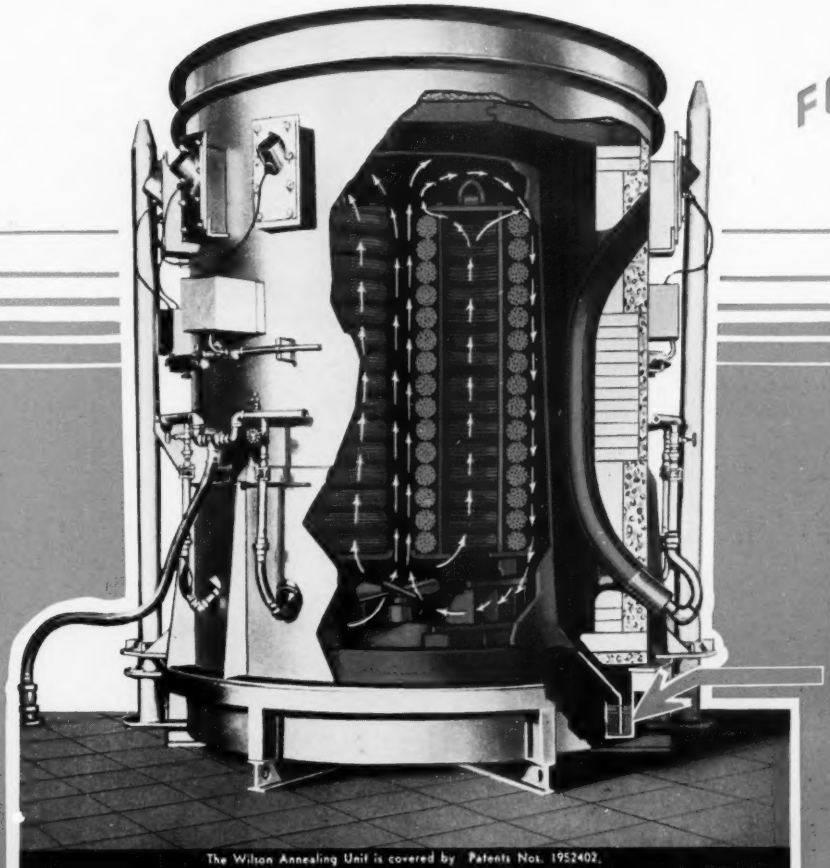
Our first Canadian installation for rod spheroidizing and wire bright annealing for flat and round wires will soon be in operation.

Whether it is low carbon or high carbon material, bright or process annealing or spheroidizing, Wilson Furnaces will produce a more uniform product in less time and at lower cost per ton.

We offer complete installations—Furnaces, Bases, Inner Covers, Temperature Controls, Gas Atmosphere Generators, Wire Spiders and Wire Loading and Stripping Machines—all engineered as a unit.

FOR FLAT WIRE

FOR ROUND WIRE



Wilson engineers are WIRE annealing specialists and what they are doing for others they can do for you.

Note the liquid seal to insure complete bright treatments.

The Wilson Annealing Unit is covered by Patents Nos. 1952402, 2068477, 2078356, 2081612, and other patents pending.

An Exclusive Development of

LEE WILSON ENGINEERING CO

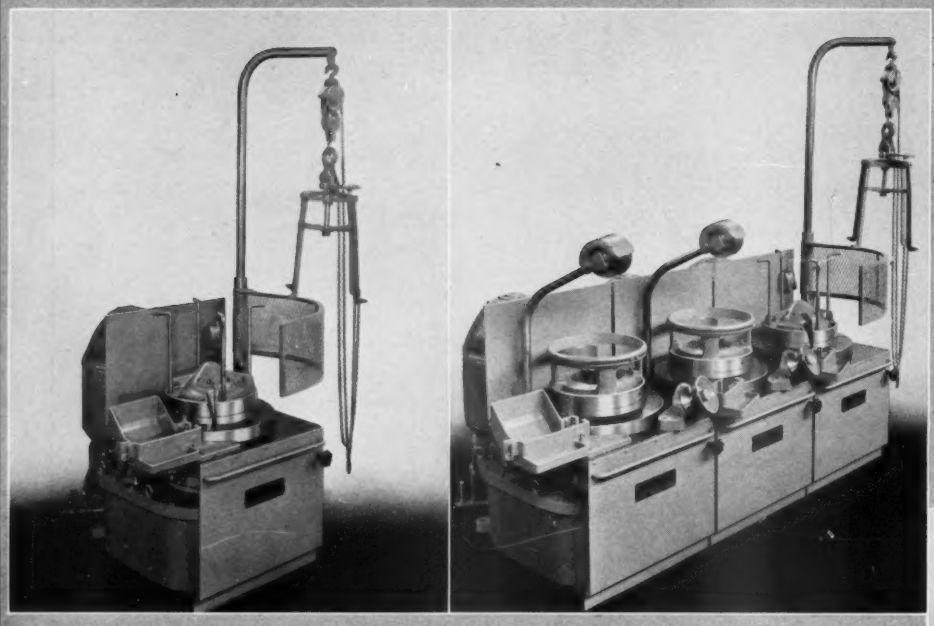
1370 Blount Street • Cleveland, Ohio

The AETNA WIRE DRAWING UNIT

PATENTS PENDING

ADAPTABLE for SINGLE DRAFT or MULTIPLE DRAFT CONTINUOUS DRAWING

Featuring ★ ★ ★ ★ ★ **UTILITY WITH MAXIMUM FLEXIBILITY**



★ **WIDE SPEED RANGE**

★ **POSITIVE SAFETY CONTROL**

★ **WATER-COOLED BLOCKS AND DIES**

★ **INDIVIDUALLY MOTORED BLOCKS**

COMBINATIONS---of Two or More 16", 22", or 26" Aetna Units are available for any continuous wire drawing requirement.

Superior Wire Quality is attainable on all Aetna-Standard Wire Machines at unusually **High Drawing Speeds** through effective **Water-Cooling.**

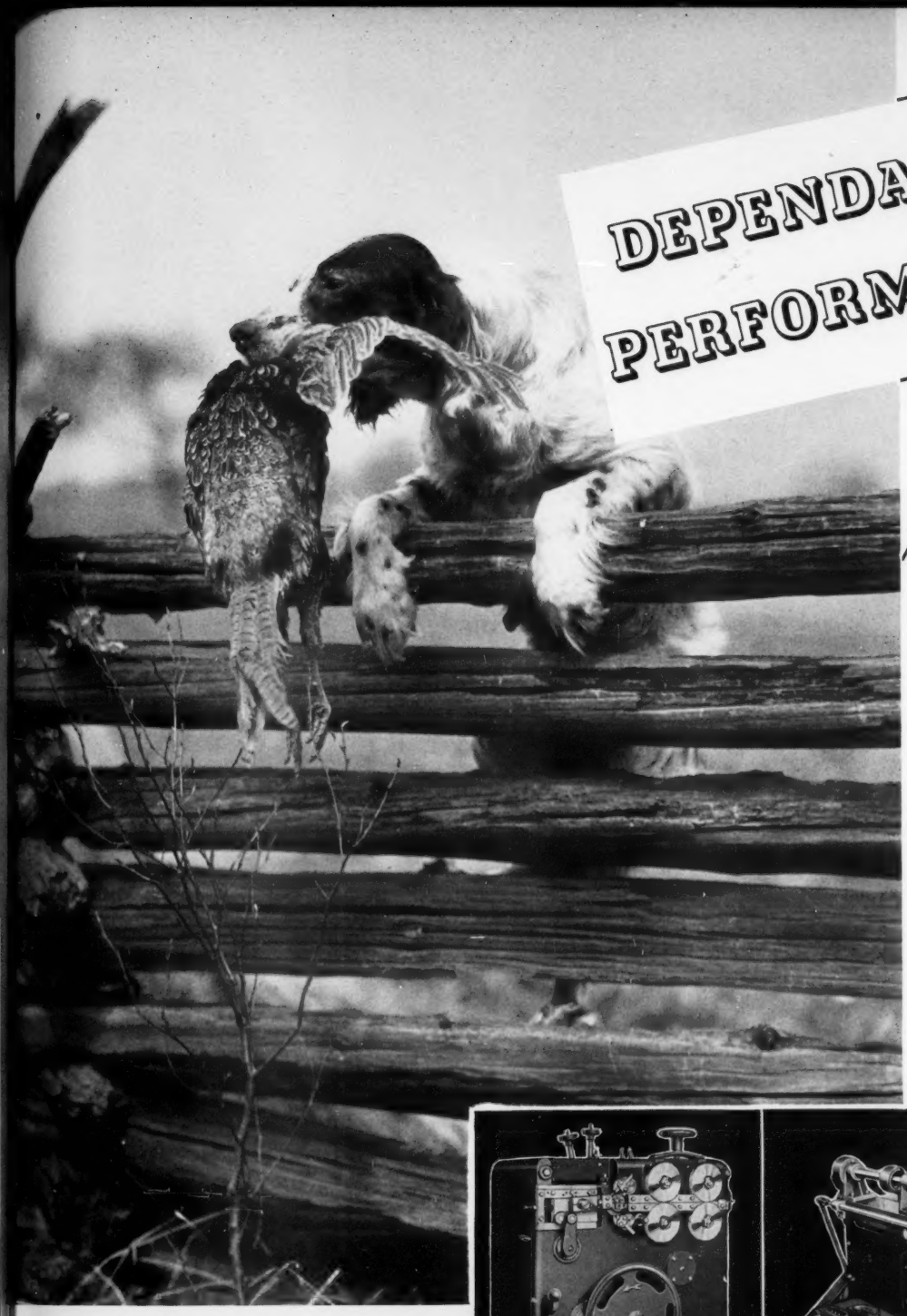
THE **AETNA-STANDARD** ENGINEERING COMPANY

CONSULTANTS—DESIGNERS AND BUILDERS TO THE STEEL AND NON-FERROUS INDUSTRIES

YOUNGSTOWN, · OHIO, · U. S. A.

ASSOCIATED COMPANIES

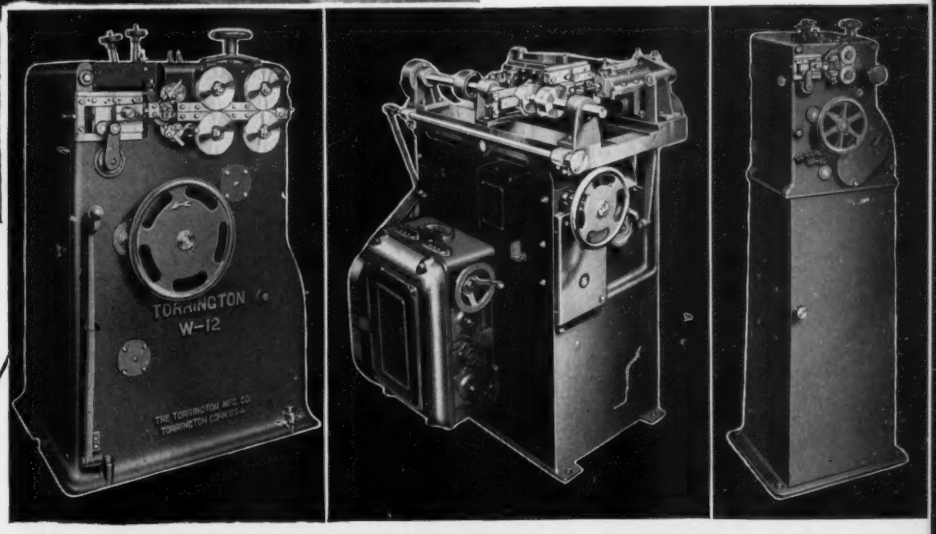
Head, Wrightson & Co. Limited, Thornaby-on-Tees, England. Aktiebolaget Arboga Mekaniska Verkstad, Arboga, Sweden.



DEPENDABLE PERFORMANCE

The dependable and superior performance of Torrington Spring Coiling and Winding Machines is attested by the successful experience of scores of springmakers who are adding profits and customers' good will by producing, in less time, more and better springs—springs made to a new standard of accuracy and uniformity. It will pay you well to investigate the many new and exclusive patented features which contribute to this superior performance. See for yourself how Torrington design makes for rigidity, compactness and ease of operation and adjustment.

Descriptive bulletins for Segment and Clutch Type Coilers, also Torsion Spring Winders, will be sent on request. Guaranteed production figures will be quoted for sample springs submitted.



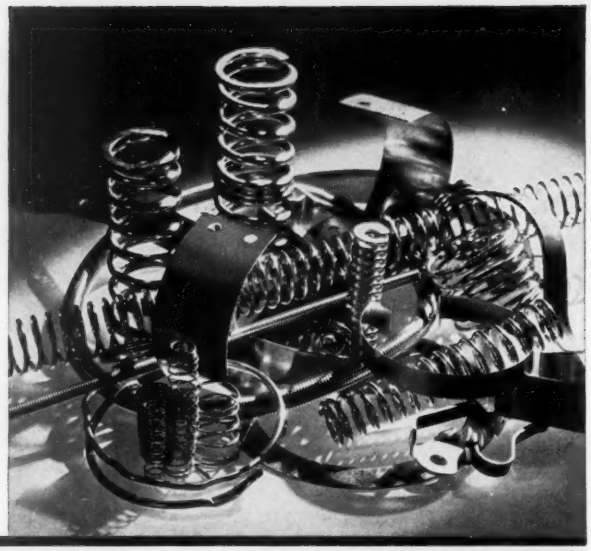
Shown at the right are two sizes of Torrington Segment and Clutch Type Coilers and (center) a Torrington Torsion Spring Winder.

The Torrington Manufacturing Co. is associated with W. H. A. Robertson & Co., Ltd., of Bedford, England.

Spring Machines by

TORRINGTON

THE TORRINGTON MANUFACTURING CO.
TORRINGTON, CONNECTICUT • • • • U. S. A.



Specify SEYMOUR Nickel Silver & Phosphor Bronze Wire

FOR SPRINGS THAT GIVE SERVICE

SEYMOUR NICKEL SILVER is an alloy of copper, nickel and zinc. It can be given any degree of hardness, from dead soft to highly resilient spring stock. It will take numerous successive draws without anneals. Because of its silvery white color, it is a very desirable base for nickel, silver and chromium plating. With chromium plate, no underplate is necessary.

It is highly corrosion resistant. Widely used not only for springs, but also, in wire of varying degrees of hardness, for design details of jewelry. In rod, particularly when leaded, it is admirable for the manufacture of knobs, nuts, bolts and turned items of all kinds. In sheet it is excellent for drawing and spinning, especially in the manufacture of silver-plated ware. Samples on request.

SEYMOUR PHOSPHOR BRONZE is an alloy of copper, tin and phosphorus. Special properties: great toughness, extreme resistance to corrosion, and ability to withstand "fatigue" over long periods of time. Because of this last, it is much used, mostly in sheet, for contact springs in electric switches.

Because of its corrosion resistance, it is very dependable for springs that must function uninterruptedly in fresh and salt water dampness, such as in marine meters, clocks and other instruments. It is stubbornly resistant to abrasion, practically indifferent to thermal changes, and offers no fire risk from sparks when struck or from "arcing" when charged. Samples and catalog on request.

SEYMOUR

a name to remember

WHERE QUALITY COUNTS

THE SEYMOUR MANUFACTURING CO., 62 FRANKLIN STREET, SEYMOUR, CONN.

WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable

DRAWING—ROLLING—EXTRUDING—FORMING—FABRICATING

Vol. 14 MARCH, 1939 No. 3

Designated as

Official Publication By The Wire Association

Contents

Microscopic Precision Features Manufacture of Fourdrinier Cloth ..... By William R. Murphy 153

The development of the manufacturing processes through a period of 36 years, at the Lindsay Wire Weaving Company, of Cleveland, Ohio, is described in this article.

New Copper Cable Standard Adds To Series on Wires and Cables ..... By J. J. Morrison 161

The latest of 18 standards providing for concentric copper stranding for insulated conductors.

New Improvements At Republic's Gadsden, Alabama Plant 163

Stresses in Helical Compression Springs Present Status of the Problem ..... By C. T. Edgerton 165

A discussion of the investigations made to date on this subject, together with an outline of the problems to be solved in the future.

Improved Continuous Insulating Equipment By John R. Stricklen 171

The principal features of this equipment and the reasons for their adoption are discussed in this article.

Exports and Imports of Wire 173

A Review of Recent Wire Patents 178

'Round the World with the Wire Industry 180

Index to Advertisers 189

Where to Buy 190-191-192

—ASSOCIATE EDITORS—

Kenneth B. Lewis, Consulting Wire Mill Engineer
W. H. Spowers, Jr., Consultant on Galvanizing
Lancaster, Allwine & Rommel, Consultants on Patent Information
European Correspondent
Paul Fidrmuc

Richard E. Brown, General Manager
R. S. Spengel, Business Manager
Edwin M. Dixon, Advertising Manager

Publication Office: Washington, N. J.
Executive Office: 17 E. 42nd St., New York, N. Y.
Annual Subscription, U. S. $5.00, Canada $5.00

50 Cents a Copy Issued Monthly Foreign, $7.50

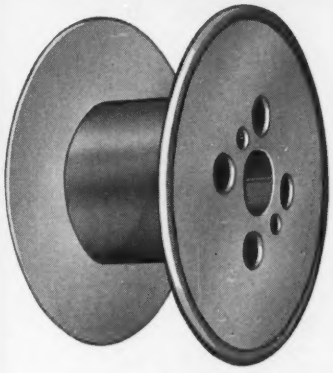
Copyright 1939, Quinn-Brown Publishing Corp. WIRE AND WIRE PRODUCTS is fully protected by copyright and nothing that appears in it may be reprinted wholly or in part without permission.

WIRE & WIRE PRODUCTS, Vol. 14, No. 3, March, 1939. Executive Office, 17 East 42nd St., New York, N. Y. Published by the Quinn-Brown Publishing Corp., Richard E. Brown, President; R. S. Spengel, Secretary and Treasurer. Publication office, 13 West Church Street, Washington, N. J. Subscription price: U. S., $5.00; Canada, $5.00 per year, 50 cents per copy; Foreign, $7.50 per year. Entered as second class mail at the Post Office, Washington, N. J., under Act of March, 1879.

BALANCED

For High Speed and Precision Work

APCO MOSSBERG STEEL REELS

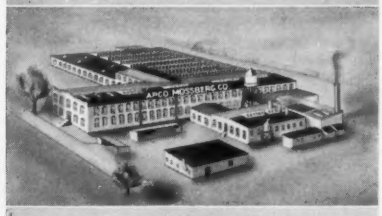


No wonder more and more Apco Mossberg Steel Reels are used every year as standard equipment in the wire industry! Apco Mossberg . . . the original Frank Mossberg Co. . . . originated the steel reel idea . . . and have been training experienced workmen in their manufacture ever since. Each job is a "special" and receives the personal attention and inspection of Apco Mossberg engineers.

FREE ENGINEERING SERVICE

We will gladly make drawings, blueprints, or suggestions without the slightest obligation to you. Write for quotation today.

REELS . . . SPOOLS . . . BOBBINS

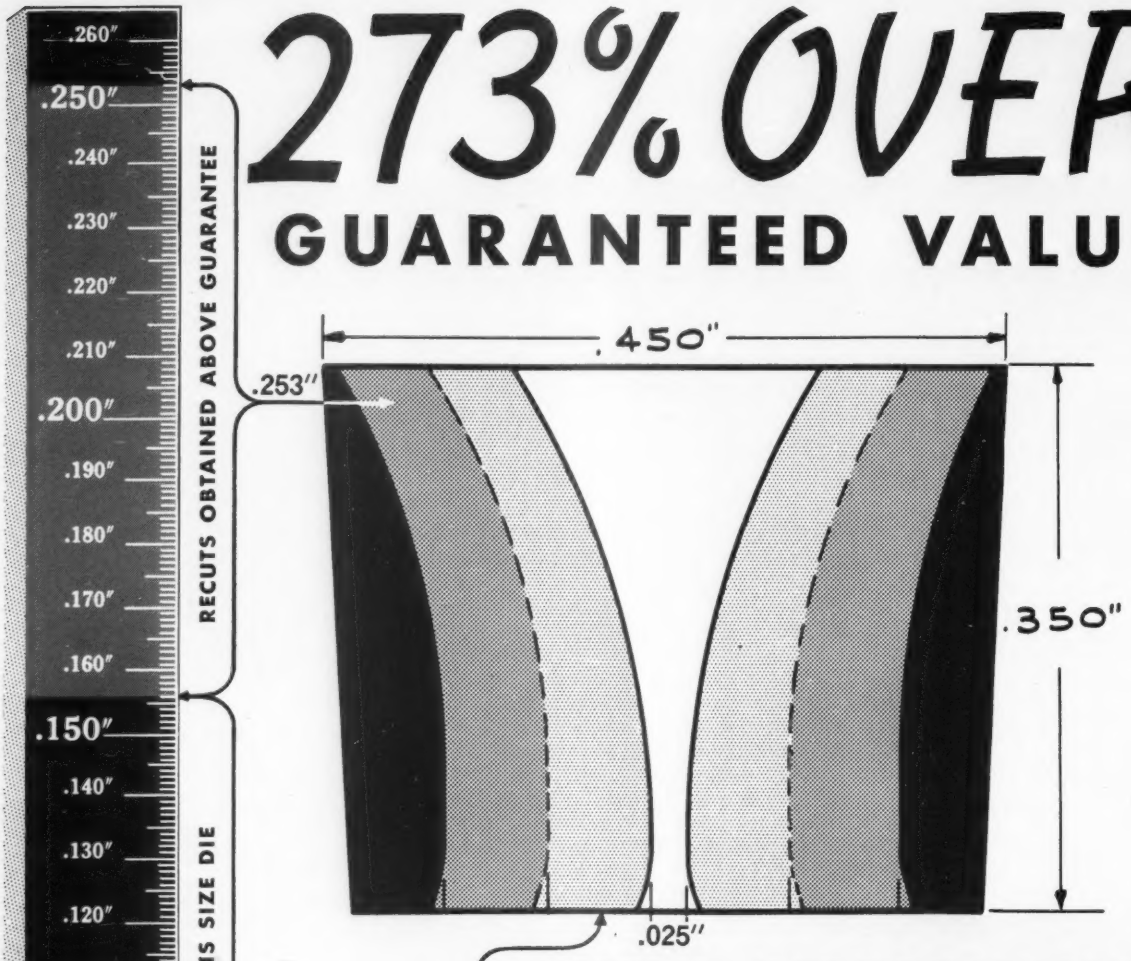


APCO MOSSBERG CO.

(The Original Frank Mossberg Co.)

21 Lamb St., Attleboro, Mass.

273% OVER
GUARANTEED VALUE



EXTRA PERFORMANCE AT NO EXTRA COST . . .

THE FIRTHALOY Die Nib illustrated is one of two that produced 4,811,211 pounds of perfect finished wire.

Dies were purchased at size . . . . .025″

Guaranteed to recut to . . . . . .156″

(Where they had drawn 1,291,250 lbs.)

They are still in service at . . . . . .253″

Having produced 4,811,211 lbs., or 3,519,961 lbs. over guaranteed value.

Initial cost may be high but FIRTHALOY Dies are the cheapest in the long run.

FIRTH STERLING FIRTHALOY QUALITY

FIRTH-STERLING
STEEL COMPANY

Works: McKEESPORT, PA.
NEW YORK CHICAGO
HARTFORD CLEVELAND
DETROIT LOS ANGELES
PHILADELPHIA DAYTON
GLOBE WIRE DIVISION
McKEESPORT, PA.

WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip.
Wire Products and Insulated Wire and Cable.
DRAWING --- ROLLING--- EXTRUDING --- FORMING --- FABRICATING

Vol. 14 MARCH, 1939 No. 3

Microscopic Precision Features Manufacture of Fourdrinier Cloth

By William R. Murphy,
Cleveland, Ohio

The development of manufacturing processes over a period of 36 years, at the Lindsay Wire Weaving Company of Cleveland, Ohio, is described in this article. ✦ ✦ ✦ ✦ ✦

IN relating the story of Fourdrinier wire cloth manufacture, let us go first to the paper mill, where the wire cloth is used, and see just **how** it is used, and why it is necessary that the wire cloth be made as accurately as human hand and eye, assisted by the latest scientific devices procurable, can make it.

✦ ✦ ✦

How the Paper Mill Uses The Wire Cloth

THE Fourdrinier machine for manufacturing paper, which was invented and developed by **Henry** and **Sealy Fourdrinier,** assisted by **Bryan Donkin,** an engineer, in England, at the beginning of the nineteenth century, uses an endless web of wire cloth to drain the water from paper pulp, when the pulp is at a stage of about 99% water.

✦ ✦ ✦

THE Fourdrinier "paper machine," is the most important feature of the paper mill. It produces a sheet of paper, after a dozen or more preliminary processes have taken place on the wood pulp. The Fourdrinier wire cloth is used to form a sheet from the liquid paper stock.

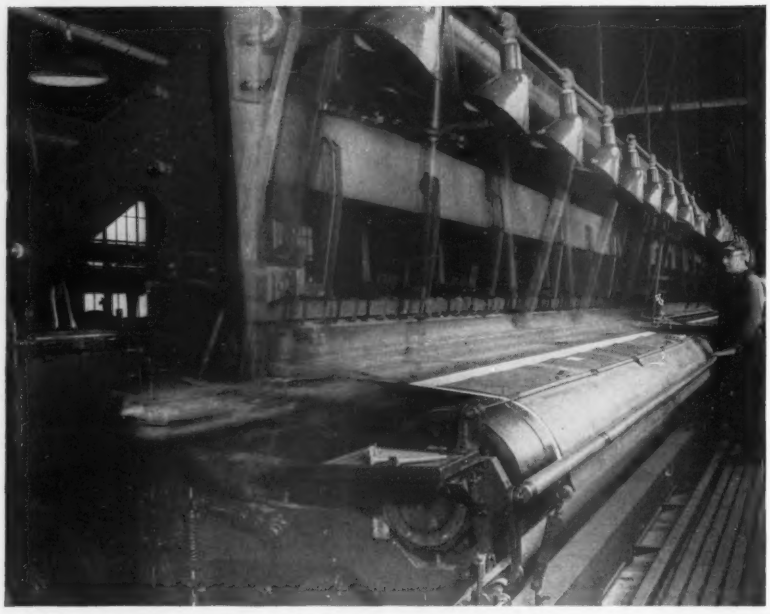
THE RAW MATERIAL—These rolls of brass and phosphor bronze wire will be drawn into the fine strands used in weaving wire cloth for many of the paper mills of the nation. ✦ ✦ ✦ ✦

✦ ✦ ✦

THE continuous flow of the paper stock comes from the beater chest. It then goes to the Jordan for further refining, then to the regulators for controlling its consistency. It then passes into the machine chest, from which it is pumped in a continuous stream to the paper machine stuff boxes. Here the stock is screened to remove all lumps, coarse fibers, and foreign materials, then passes into the flow box. The machine inlet supplied by this flow box, uniformly releases the stock onto the Fourdrinier wire cloth.

✦ ✦ ✦

THE endless wire belt acts as a screen, traveling at rates of 400 to 1500 feet per minute, depending on the various types of machines. The action of the screen is



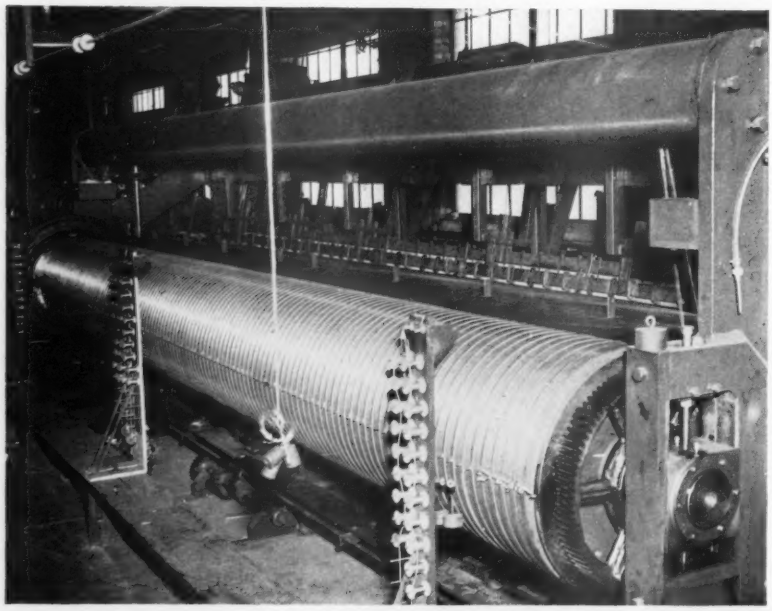
LOOM IN ACTION—The moving parts of the machine (seen as a blur in the picture) are "beating up the shute wire," an operation based on the principle of the old carpet loom familiar to an earlier generation. The woven cloth is covered with canvas to protect it from damage.

assisted by a transverse shaking motion, which spreads the fibers evenly on the surface of the wire and arranges them as they are going to lie when the sheet is finished. About 20% to 30% of the moisture is drained from the pulp by the wire cloth, assisted by the action of "suction boxes" under the wire screen, and the table rolls. The constant shaking of the cloth also helps to form the sheet by criss-crossing the fibres.

✦ ✦ ✦

THE screen is supported by rolls on which it moves, stretched taut to form a smooth surface on which the paper is formed into sheets. A deckle at either edge of the wire cloth prevents the pulp from flowing over the sides.

✦ ✦ ✦



BACK VIEW OF LOOM—The drum or "beam" in the foreground feeds 16,380 strands of wire into the loom. In the Lindsay plant there are 63 looms of varying sizes which weave the wire strands into fabric.

THE stock, which now resembles paper for the first time, leaves the wire screen and is drawn into the "drying presses," assisted by large felt belts. The water content is reduced from 80% to 60% in the presses, the balance being removed in the driers, a series of steam-heated rolls, over which a canvas-like conveying belt and the paper pass.

✦ ✦ ✦

RETURNING to the Fourdrinier, the woven wire screen runs until the wear from the suction boxes and rolls, or cracking caused by bending, or corrosion, causes it to fail. The wire cloth life in a paper mill varies from two weeks to three months, which means "repeat business" to the weaving concern.

✦ ✦ ✦

The Manufacture of Fourdrinier Wire

BRASS and phosphor bronze wire in 50 to 200 pound coils is used. This material is first subjected to a laboratory examination to determine whether it is up to specification as to alloy and anneal.

✦ ✦ ✦

Sequence of Operations

BEGINNING with the raw wire in coils, the following operations take place in producing the Fourdrinier wire cloth:

1. Raw stock received and stored in Materials Storage
2. Process Drawing
3. Process Annealing
4. Some process wire placed in Storage for Rush orders
5. Finished Size Wire Drawing (.0045" to .024")
6. Tube Annealing and Spool Winding
7. Spools trucked to Wire Storage
8. Wire taken out of Storage to looms for winding on
9. Winding wire on loom
10. Threading up for weaving
11. Weaving into wire cloth
12. Wire cloth taken off loom and wound on cut-out poles
13. Taken to Springer apparatus
14. Cut to approximate length required by order
15. Taken to Seam Cutting table
16. Seamed (one of three types)
- **(a) Sewed**
- **(b) Brazed**
- **(c) Welded**

17. Stretcher operation

18. Boxed for shipment
19. Trucked to Shipping Department
20. Shipped via truck to freight station.

✦ ✦ ✦

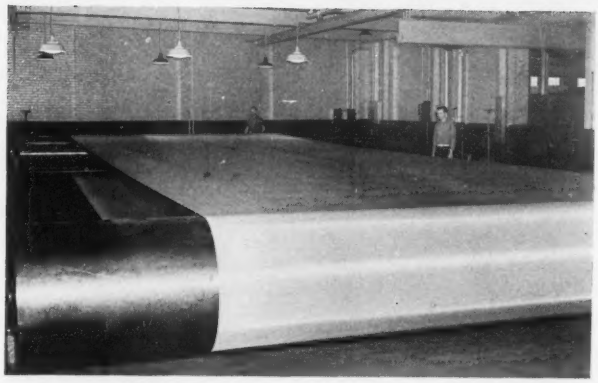
Wire Drawing

STRANDS of raw wire, .057 inch in diameter, are placed on reels and passed through a series of diamond dies, in a soap solution for lubrication, each die reducing the diameter about one gauge number in the B&S scale. This cold working by the diamond dies makes the wire considerably harder and requires two process anneals before the wire reaches its final size, which is as fine as .0045 inch. The wire is tested very frequently for diameter, using a micrometer at each drawing operation. A portable electric welding machine is used to join the ends of the 50 to 200 pound coils to form a continuous strand. Small welding machines are also employed for this purpose, for work in the finer sized wires at the Finished Size Wire Drawing machines. This method eliminates frequent rethreading of the drawing machines.

✦ ✦ ✦

Process Annealing

IT is necessary to soften the wire for redrawing purposes. This operation is called "process annealing." The coiled wire is heated in controlled electric furnaces to a temperature of about 1000 degrees Fahrenheit. It is in this chamber from two to six hours. In the cleaning process, the wire is dipped in vats of acid, then thoroughly drenched with water flowing in a continuous stream through tumbling barrels.



FINISHED PRODUCT—After seaming, the wire cloth is spread on this large stretcher, where it is smoothed and given a final inspection. This type of cloth, which has a high golden sheen, is called "Fourdrinier" fabric, so termed because the process was developed by a man of that name. ✦

✦ ✦ ✦

Finished Wire Drawing

ONE man threads up and operates eight finished size machines. Forty of these machines, specially built for filling large steel spools, are used in this work. The hard drawn wire is then placed on wooden platforms and trucked to the Furnace where it is annealed in the Tube Furnaces to the specified temper.

✦ ✦ ✦

Tube Annealing

THE electrically heated Tube Furnaces are very accurately controlled for temperature. Auxiliary apparatus detects any possible failure of this control and warns the operator.

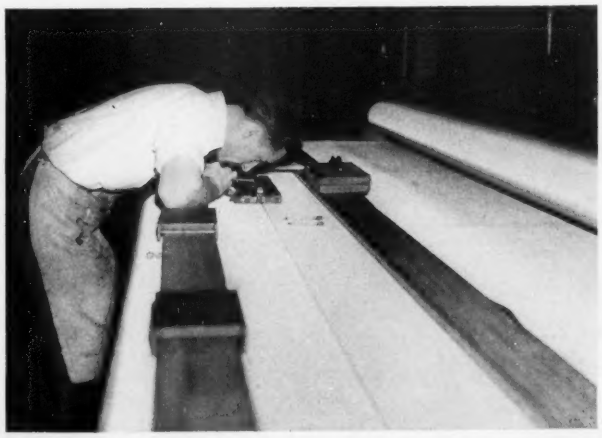
THE temperature is regulated according to the diameter and type of wire, ranging from 1000 to 1400 degrees Fahrenheit. So exact is the control that a temperature within a 5-degree variation can be maintained indefinitely.

✦ ✦ ✦

EACH strand of wire passes through its own tube and is bright annealed with the aid of the reducing atmosphere in the tube, and its very brief heating to the annealing temperature. In case a wire should snag in the tube while in a heated condition, its diameter would be reduced for a short section which later would cause trouble in the weaving. Therefore an automatic device breaks a snagged wire so that the operator can tell that this part of the wire cannot be used.

✦ ✦ ✦

AS the strands come from the heat bath, at a constant



SEAMING—The woven cloth is being joined together by this expert craftsman. He uses an acetylene torch for the operation. This is one of several methods of seaming developed at the plant. ✦ ✦ ✦

The Bright Anneal Tube Furnace, electrically heated and temperature controlled, in which the wire is annealed by the aid of the reducing atmosphere and heating. ✦ ✦ ✦ ✦ ✦

speed, each strand moves to its appointed place on a revolving spool. The winder traverse mechanism feeds the single threads to the spools in exact alignment, reversing itself when a complete strand is laid to form one more level on the spools. One operator takes care of a furnace, one of his duties being to test each spool of wire for stretching and tensile strength. Each operator tags his spools so that they may be identified later should any defects show up.

✦ ✦ ✦

FROM the Tube Furnaces the spools of wire are trucked to the Wire Storage Building. The spools, each weighing about four pounds, are later taken in boxes to the looms for "winding on," or to the shute winders, except those warp spools which are under weight. These are sent to the warp winder for rewinding to complete the spools.

✦ ✦ ✦

Bobbin Winding

THE shute wire is wound on specially designed metal bobbins. They are ingeniously shaped and wound so that when the wire is suddenly pulled off the end of the bobbin, it does not tangle or loosen up the turns not yet used. The winder operator must observe extra precaution that the proper sized wire is on each bobbin.

✦ ✦ ✦

Winding On

WHEN the warp wires remaining on the loom are too short to make another cloth, these short ends are removed and the loom then requires the "winding on" operation. At this time the loom is carefully inspected for necessary repairs or adjustments by a trained maintenance man. The grooved beam roll is lowered and engaged with a drive gear which rotates the roll for the winding on.

✦ ✦ ✦

THE beam roll at the rear of the loom, extends the full width of the loom, and is about 24″ in diameter. It is made with a series of grooves on 2″ centers. The grooves are about 1¼″ deep, and are separated by narrow ribs on which are small pegs for fastening the ends of the warp wires.

✦ ✦ ✦

FULL spools of warp wire are placed on a special portable rack, located at the front of the loom. If an eighty mesh wire is to be woven, 160 spools are placed on spindles in the rack. The wire strand from each spool is fed to a marshal at the large grooved beam roll. This marshal delivers the wires to one two-inch wide groove in the beam roll, under uniform tension, and directs each strand to its proper location, so that it will not tangle with adjacent wires as the beam unwinds.

✦ ✦ ✦

EACH groove is filled in this manner with an equal and predetermined number of turns of the beam roll. A weaver and a helper require about one week, working eight hours per day, to wind on a loom of 200″ width. A beam counter assures the same number of turns of the roll to each groove, so that all grooves will have equal lengths of wire. Generally sufficient warp is wound on to weave from eighteen to twenty Fourdrinier wires of eighty to 100 foot lengths.

✦ ✦ ✦

IN order to avoid frequent stops for replacing empty spools while winding on, full spools are started on the rack. However, as the spools of warp wire are received from the wire drawing department, quite frequently there are spools which are only partly filled.

✦ ✦ ✦

THESE partly-filled spools are sorted out, then the end of a strand of one spool is brazed with silver solder to the end wire of another partly-filled spool. This operation is performed by hand, with the aid of a small gas flame. The two spools are then placed on a warp winder and all of the wire is wound on one of the spools.

✦ ✦ ✦

THE warp wires are threaded through the heddles and the reed. A heddle is a thin strip of steel with an eyelet in the center and is mounted in the heddle frame. Each strand of wire has its own heddle. In plain weave, two heddle frames are used and every other wire is in the same heddle frame. In a "longcrimp" or "semi-twill" weave, three heddle frames are used and every third warp wire is in the same heddle frame.

✦ ✦ ✦

AS a strand is threaded through the eyelet of the heddle by one man, another man takes the same strand and feeds it through the reed. A loom reed is made up with a large number of thin steel strips or dents bound at the top and bottom to form narrow slots for the warp wires to pass through. A 60 mesh reed has 60 dents per inch and holds the warp count constant through the weaving operation. The face of the reed is used to drive or beat up the shute wire in the weaving operation. After the warp wires are

Metallurgical Laboratory, containing the Tensile Strength Testing Machine, Photographic Microscope and other scientific apparatus for analyzing raw material and finished wire cloth. Mr. A. Fred Crossman, President and General Manager, is shown at the right, reading a "stress strain" diagram on the Tensile Testing Machine. The engineer at the left is taking a microscopic photograph. ✦ ✦ ✦ ✦ ✦

threaded through the reed they are tied to a steel strip attached to the end of a canvas sacking.

✦ ✦ ✦

THE sacking is used to save the time of fastening the warp wires to the cloth roll which is located some distance from the reed. After the threading up is completed, the reed and sley cap are placed in position and the heddle frames are replaced. A few shots of shute wire are then woven to hold a small strip of steel. Then the warp wires between the steel strip and the cloth sacking are cut and the sacking is removed from the loom. The warp ends, with the steel strip, are hooked over the spikes on a countersunk groove in the cloth roll. Final adjustments on heddle frames, and a careful inspection are now made, and the loom is ready to weave the cloth.

✦ ✦ ✦

"MESH" in wire cloth is the number of wires and openings per inch. Fourdrinier wire cloth is usually made with a higher warp count than shute count. For example: "60 x 40 mesh" means 60 warp wires and 40 shute wires in one square inch of cloth.

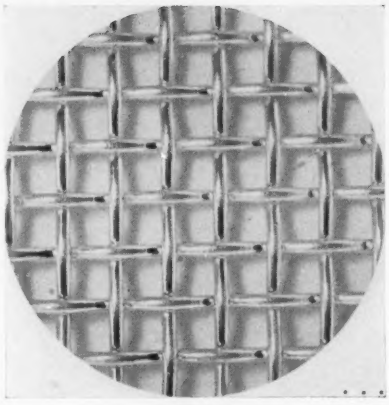
✦ ✦ ✦

Weaving

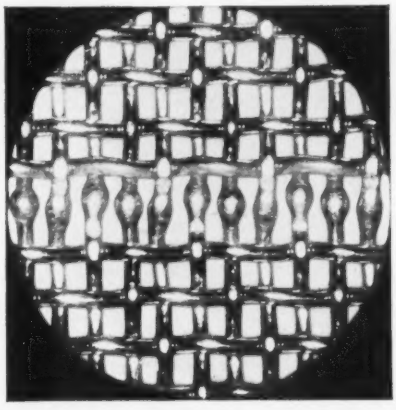
WEAVING wire cloth is an extremely accurate proceeding. The weaver must be very alert and must be able to stop the loom instantly in case of any irregularities in the mechanism, the wire, etc. The shute count is carefully made and recorded at one foot intervals all through the weaving of a wire cloth. The weaver replenishes the shuttle with full bobbins and he must be very careful that the sley does not fall when a shute wire has not been placed by the shuttle.

✦ ✦ ✦

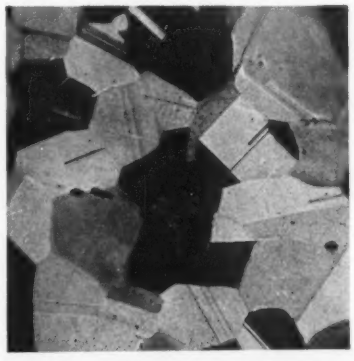
CLOTH is woven at the average rate of about one foot of length per hour. The fineness of the mesh determines this rate. Between beats of the loom, the shuttle is shot across the entire width of the loom, and puts a strand of shute wire in front of the reed in the shed of warp wires formed by the heddles. A double blow of the sley and reed drives the shute wire into the proper mesh at the face of the woven cloth.



Microscope photo of 12 mesh all brass cylinder cloth magnified 8 times. ✦ ✦



Microscope photo of welded seam in Fourdrinier wire magnified 15 times. ✦ ✦



Microstructure of annealed phosphor-bronze warp wire magnified 500 times. ✦ ✦

Springer Operation

WHEN the weaving process is complete, the wire has a "curl" which must be removed in order to present a smooth, flat surface for use in the paper machine. The wire cloth is taken off the loom onto a "cutout" pole, and conveyed to the Springer apparatus for uncurling. Then it is placed onto another roll and by electric power it is passed over a flat steel blade which takes out the curl, and it is then sprung to a flat surface.

✦ ✦ ✦

AFTER the Springer operation, the wire cloth is placed on the Springer Inspection table, a wooden platform 60 x 23 feet in area. It requires three or more men to lay the sheet on this platform, which has previously been thoroughly swept and cleaned to prevent the wire from gathering any foreign substance. Here occurs a most rigid inspection of the wire mesh. If any defect is found that would cause the paper mill trouble, the wire is not used. The defect is removed and the balance of the wire cloth is placed in Cut Cloth Storage.

✦ ✦ ✦

Cutting Table

AFTER the Springer Inspection, the wire cloth goes to the Cutting Table, where a very precise job of cutting is done, it being necessary to cut exactly between two shute, or crosswise, strands in order to secure proper length of "pickets" or warp wire ends. In this step the wire is cut to predetermined lengths, which is about ½% short of the length as shipped, the additional length being secured by stretching. From the Cutting Table the wire cloth goes to the Seaming Departments. Some wires have sewed seams, while others have the brazed, or welded seams.

✦ ✦ ✦

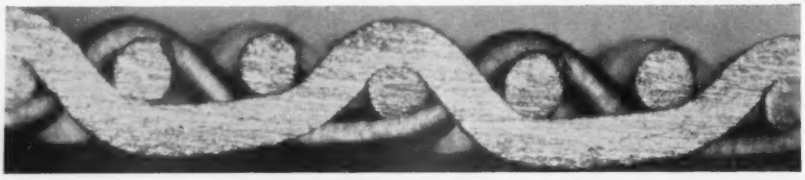
Silver Soldering for the Brazed Or Welded Seam

EXTREME precision is required for all types of seams. The three essential qualities of a "good" seam are: flexibility; good

drainage; and tensile strength. The end of the wire is placed in a brazing clamp and the seamer applies a brush dipped in silver solder to the last shute wire only. No other strands must be touched. The solder is then melted with an acetylene torch. A mercury vapor lamp, operated on a special crane, is used for illumination, and the operator wears special glasses, fitted by an eye specialist, to protect the eyes and to magnify the strand upon which he is working. This is extremely delicate work.

✦ ✦ ✦

THE same treatment is applied to the other end of the same cloth, by remelting the silver solder, and when the two ends are butted together an endless belt is created. The silver solder is of high strength, and a very neat and rugged seam is made by this process. This type seam is required for the faster and newer paper machines.



Microscope photo of half sectioned warp wire in long crimp weave of Fourdrinier wire cloth magnified 15 times.

✦ ✦ ✦

Seam Welding

THE welded seam is accomplished by joining the ends of the warp wires, after removing the last shute wires, and applying a very accurately controlled acetylene flame to butt-weld these warp wires and form proper sized ball joints. The drainage through this seam is very important.

✦ ✦ ✦

Sewed Seam

THE sewed seam is laced up like a belt. Specially prepared sewing wire is used to unite the ends of the Fourdrinier cloth. These sewing wires are threaded through the small openings between the last shute wires in a proper design to give good drainage, strength and flexibility.

✦ ✦ ✦

Testing Seams and Cloth

VARIOUS testing machines are used for testing the wire cloth and seams. They test for fatigue, tensile strength and wear. Separate type tests are made, rather than a combination, such as in an actual paper mill condition, so that the various properties can be identified. One machine tests a belt 12″ wide by 10′ long. It has four 6″ rolls over which the wire travels at the rate of 2000 feet per minute. It employs a regular paper machine guide to keep the belt centered on the rolls. Any weakness in the cloth or seam as to bending or fatigue is determined by this type of test. Belts on this type of test run for a considerable length of time.

✦ ✦ ✦

ANOTHER type of tester is used to give an "accelerated fatigue test" for the development of new type seams. In seam development work results of this test are quite valuable because of the ease and short time required to find a weakness.

✦ ✦ ✦

Stretcher Operation

ONE of the most important processes in wire weaving is the Stretcher Operation which includes these separate tasks:

1. Convey wire cloth to stretcher table on poles and raise the cloth, by chain hoists with leather slings, to the table so that the cloth forms a tent shape.

2. Inspect seam inside the wire cloth belt.

3. Insert two rollers by cantilever carriage into the cloth tent so that the cloth may be stretched from roll to roll.

4. Lower the cloth to the rolls and stretch to medium tension.

5. Measure the rolls and make sure they are exactly parallel.

6. Inspect the entire length of the cloth.

7. Lace in the edges at the seam for ¾″ for reenforcement.

8. Roll the seam.

9. Stretch the cloth by moving the rolls further apart.

10. Check the cloth for length after stretching.

11. Remove the rolls.

12. Roll up the cloth on poles and box it for shipment.

THE measurement of all wire cloth is checked before and after stretching, so that there can be no doubt about the length added by stretching. The length was also checked at the Springer Table before the cloth went to the cutting table.

✦ ✦ ✦

DURING the Stretcher Operation, the cloth receives its final inspection, which must be in fine detail. The operators go over the entire cloth and examine the seam with a microscope and magnifying glass to detect flaws.

✦ ✦ ✦

ONE roll is called the "driving roll." The other is "driven" and its location is determined by the length of the wire. The Stretching Table has previously been swept and cleaned in order to remove any small particles or grit. The mesh is carefully checked as it passes over the "driving roll," and slight ridges, or projections, are rolled down with metal rollers. An operator stands at the driving roll and "inches" the wire over the roll during the final inspection.

✦ ✦ ✦

Packing Wire Cloth for Shipment

WIRE cloth is easily damaged, and extreme precautions are taken to prevent damage from the bumping all freight must take. A long, narrow box is used, different lengths being provided for different cloth widths. The box is reenforced at all corners. Runners on the underside permit easy handling in shipping and receiving.

✦ ✦ ✦

BEFORE placing the wire cloth in the box, it is tightly rolled on three wooden poles. The ends of the poles are tied securely with heavy twine to prevent the cloth shifting in the box. The poles may be in pyramid formation, which often necessitates slightly changing the diameter of the poles with paper and rerolling. The cloth is

then wrapped in heavy Kraft paper, which is glued on. A ripcord is provided, so that the Kraft paper may be removed by one pull of the cord, thus preventing any damage to the cloth through the use of knives or other metal instruments. A printed warning at the end where the ripcord protrudes, guards against mishandling of the cloth at the point of destination. A slip informing the receiver of the type of cloth and size of cloth, and the order number of the purchasing firm is also attached to the wrapper.

✦ ✦ ✦

THE shipping box is first thoroughly cleaned by hand and shaken upside down to remove any chips, dust or foreign particles, and the wrapped cloth laid in the box. A wooden block, which is nailed to the ends of the three poles to reenforce the tyings, helps to prevent slipping enroute.

A LAYER of special soft wrapping paper is placed around the wrapped wire cloth, then the complete package is picked up by an electric hoist and carefully lowered into the shipping box on rope slings which accompany the wire shipment. Experiments in bumping have been carried on to determine the maximum punishment a shipment can endure and remain undamaged, and many precautions are taken as a result of these painstaking trials.

✦ ✦ ✦

THE wire cloth, now being securely installed in the shipping box, with every possible element of danger provided for, a length of felt paper is laid along the top of the wrapped cloth to keep out moisture and to add a final shock absorber to the shipment. Then the lid is screwed (not nailed) on; the necessary shipping labels glued and painted on the top and ends; and the box is ready to be trucked to the shipping department.

✦ ✦ ✦

THE boxes which are specially built for shipping wire cloth are billed to the customer and returned for credit. They can be used six or seven times before they are broken up and the good pieces salvaged.

✦ ✦ ✦

Shipping

USUALLY wire cloth, when boxed and properly labeled for shipment, is hauled by truck to the nearest freight depot. As the paper mills want the wire cloth to be on hand when they must take the old wire off the Fourdrinier machine, it is not feasible to wait for carload shipments. Hence all shipments are on an individual basis.

The Lindsay Wire Weaving Company

THE photographs and data contained in this article describe the processes of the **Lindsay Wire Weaving Company** of Cleveland, O. This company was organized in 1903. Prior to that time, the founder of the company, **Mr. Hamilton Lindsay,** had secured patents on a power loom for weaving paper machine wire cloth which represented an outstanding advance and improvement on the looms then in use. Most of the paper machine wire cloth at that time was being woven on looms operated by hand.

✦ ✦ ✦

MR. LINDSAY interested **Mr. Alexander Winton** and his associates, **Thomas Henderson** and **George H. Brown** of the Winton Automobile Company, in his new venture. After locating a site for a factory building in Collinwood, a suburb of Cleveland, a small one-story frame building was erected. That building is shown in the center of the group of buildings in the accompanying aerial-photograph. During the time the building was being erected, the first loom was built and put into practical operation in a warehouse room in downtown Cleveland. It was then dismantled and set up in the new building.

✦ ✦ ✦

EARLY in 1905, the company began the manufacture of paper machine wire cloth known as "Fourdrinier wire and cylinder cloth." Operations were started with three looms. As the Company was a newcomer in the industry, it had to create a market for its product in competition with older manufacturers. Its early struggles were many and varied, but during the years that followed, the name of "Lindsay wires" became synonomous with quality and dependability.

✦ ✦ ✦

HAMILTON LINDSAY died on January 8, 1932 after a prolonged illness. Immediately following his death, **Mr. A. Fred Crossman** was elected to the office of President and General Manager. During recent years, the business of the company has continued to expand. Three buildings have been erected since 1934. These buildings now house some very up-to-date and efficient machinery and equipment which were designed and built by the company's engineers.

✦ ✦ ✦

FROM a single small building and a solitary loom in 1903 to a large plant with eight modern buildings and 63 looms,—one of them the largest loom for wire weaving in the United States; the width of this loom (measuring the width of the woven cloth) is 276 inches or 23 feet; that is the story behind the steady growth of this unique business, which manufactures a **single** product for a **single** market.

✦ ✦ ✦

THE company continues to specialize in the manufacture of Fourdrinier and cylinder wire cloth; and its entire plant and equipment are engaged on that product.

✦ ✦ ✦

THE "long crimp" or twill weave is a distinctive feature of the Lindsay looms and this organization was the first to develop a seam for this weave which made the "long crimp" usable and practicable.

THE first "long crimp" wire was shipped in 1922 from the Lindsay plant. The paper mill received 88% more service from this cloth than the average. The second "long crimp" wire shipped to another mill gave 200% more service than the previous average.

✦ ✦ ✦

THE company has always kept pace with, and in some instances been ahead of the trend among paper mills for wider and faster machines. Thirty years ago, a 164″ paper machine was considered a large one. Now, the widest paper machine in this country is 251″ and another paper machine uses Fourdrinier wires that are one hundred twenty feet long.

✦ ✦ ✦

THE company now has installed the longest stretcher in the world, designed by their own engineers, and built, for the most part, in the factory. This stretcher is used to handle wire cloth up to 300″ wide and it has an extension so that even greater widths can be handled, if necessary up to 350 inches.

✦ ✦ ✦

Maintenance Department

THE Company develops its own machines as they are required, and a large and active maintenance department is operated. The Company builds its own looms, with the exception of the rolls and frames. The electric and acetylene welding is done in a room adjacent to the machine shop.

✦ ✦ ✦

Metallurgical Laboratory

THE Tensile Strength Testing machine is particularly interesting on account of the "stress strain diagram" which is drawn while the test progresses, and which reveals the "yield strength," breaking strength and elongation. On the diagram the horizontal distance shows the stretch percentage, while the vertical distance indicates the tensile strength of the drawn wire.

✦ ✦ ✦

AN electroplating machine is also used to determine the relative percentage of copper in the alloys used.

✦ ✦ ✦

Microphoto Tests for Grain Size

THE photographic microscope enables the engineer to determine the grain size, which is correlated with the strength of the metal examined. Both the surface of drawn wire and the surface of woven cloth are microscopically photographed. The microscope has a range of 8X to 2500X. A dark room provides facilities for developing negatives and prints for microscopic photos.

✦ ✦ ✦

EVERY applicable test is applied, including chemical and physical analysis with scientific apparatus; several engineers being kept busy at all times, to make sure that the product is kept up to standard. Microscopic photographs are taken and microscopes and magnifying glasses are in constant use to detect flaws of the slightest nature. The aim of the company has been to **"Make it Better and Still Better"** through the years.

New Copper Cable Standard Adds To Series on Wires and Cables

By J. J. Morrison,

Operating Department, American Steel & Wire Company, Worcester, Mass.

Member of Technical Committee, Sectional Committee on Insulated Wire and Cable (C8)

Series of 18 standards, unifying specifications for insulated wire and cable for light and power use, now enables users to select standard provisions necessary to complete technical specifications for wide variety of types of insulated wire and cable. Latest standard provides for concentric copper stranding for insulated conductors. ✦ ✦

THE standardization of concentric copper strand, Hard, Medium-Hard, or Soft, for insulated conductors, recently approved by the American Standards Association, completes a project which has been under discussion for over fifty years.

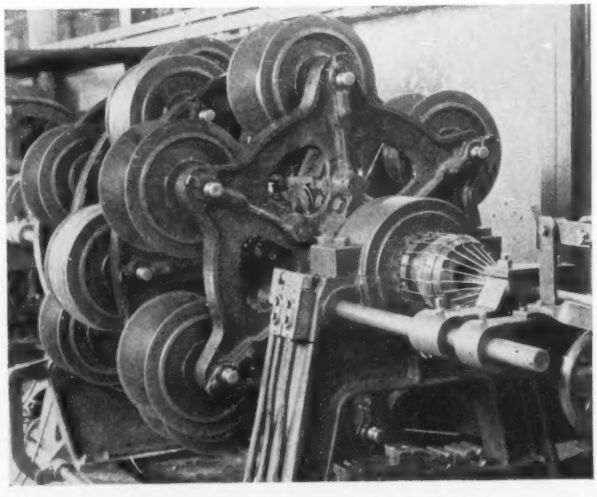
✦ ✦ ✦

IN the early 80's, with the rapid growth of the electrical industry, the need arose for copper conductors, preferably stranded for the larger sizes. At that time sizes, even of solid wire, meant little on account of the numerous gages in common use. All wire was sized by gage, and variations in diameter due to gage wear were possible even in wire shipped from a single plant. The history of determining solid wire gage sizes and the final recognition of the American Wire Gage (formerly Brown & Sharpe) as a standard gage for copper wire in the United States forms an interesting chapter in the records of standardization.

✦ ✦ ✦

DURING this period of confusion, with its multiplicity of gages, The Edison Standard Wire Gage was proposed by the Edison Electric Light Company. This gage was based on circular mil area of cross section; *i. e.*, No. 5-5000 circular mils, No. 10-10,000 circular mils, and so on. While the gage did not survive, the simplicity of expressing conductor size in circular mils was recognized and has become the basic method of expressing the size of electrical conductors in American practice. As such it should be noted that the circular mil method is purely an American practice as compared with measurements in square inches and square millimeter in European usage.

Published by Permission of American Standards Ass'n.



Machine for laying up stranded copper cable from individual wires. The front section and forming die are shown here. ✦ ✦

✦ ✦ ✦

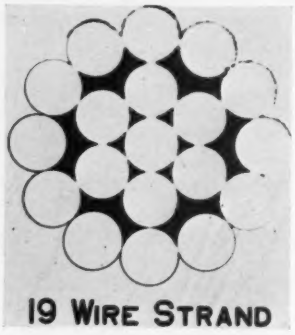
THE basic physical makeup of concentric strand is simple, as it follows a geometric rule that with round wires of given diameter the number of wires in each layer will increase by six. Thus a straight central wire is surrounded by helical layers of wires of the same diameter, the alternate layers having a twist in opposite directions. In the first layer about the central wire, 6 wires are used; in the next layer 12; then 18, etc. to form 7, 19, 37 wire cable.

✦ ✦ ✦

THE size of the stranded conductor is governed by its cross section in circular mils. Since the cross section in single wire is the circular mils of a square of its diameter in mils, the cross sectional area of the stranded conductor will be the product of the number of wires in the conductor and the circular mil area of the individual wire size used. As can be readily seen, this is far more simple than the European method of figuring in square inches and square millimeters. The sizes of stranded conductors smaller than 250,000 circular mils are more often, by common usage, stated

by means of the gage number in the American Wire Gage of a solid wire having approximately the same cross sectional area. In the tabulation in the Standard Specification, both sizes are included for convenience.

✦ ✦ ✦



19 WIRE STRAND

IN the tabulation the individual wire sizes shown are those which will give as close to the exact circular mil area required as is practically possible. This follows a definite and old practice and corresponds to that shown by the National Bureau of Standards in Circular No. 31. There is also a practice of using the nearest American Wire Gage size for the individual wires for stranded conductors where exact size is not of importance. This practice does not conform to the Standard and is used as a matter of convenience or cost.

✦ ✦ ✦

THE outside diameters of the stranded cables are not given in the tabulation but may be very readily calculated. For a cable of seven wire construction, the outside diameter is three times the diameter of one wire; for a cable of 19 wire construction it is five times the diameter of one wire, and so on.

✦ ✦ ✦

Usage Well Established

BY the Standard, the usage of the various classes of stranded copper cable is well established and follows normal practice in the industry. Class A is to be used for weather-resistant (weatherproof), slow burning and slow burning weather-resistant (weatherproof) cables. Class B is to be used for cable insulated with various materials such as rubber, varnished cloth, paper, etc., and for cables indicated under Class A where

This photograph shows a section of a concentrically stranded cable.

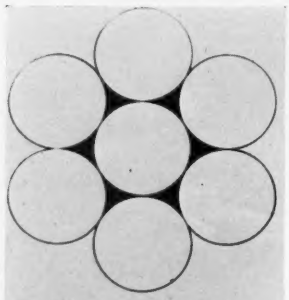
✦ ✦ ✦

greater flexibility is desired. Class C and D are to be used for cables where more flexible stranding is desired than in the other two classes. The tabulation also includes a Class AA, covering a range of sizes from 1,000,000 C.M. to No. 4 A.W.G., which is for use where a purchaser requires a cable composed of fewer number of larger wires than called for in Class A.

✦ ✦ ✦

A PROCEDURE for joints in the individual wires comprising the cable, and particularly their frequency, is definitely established, thus clarifying a point which has been misunderstood and a frequent cause for argument between the purchaser and the manufacturer.

✦ ✦ ✦



7 WIRE STRAND

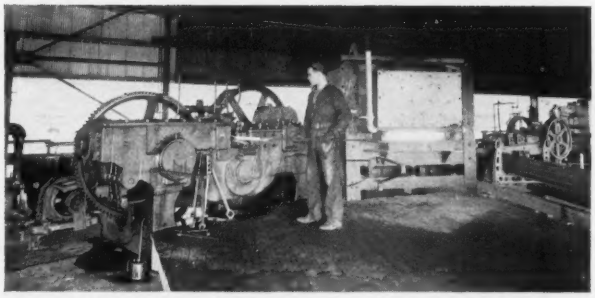
THIS standard culminates many years' work by the National Bureau of Standards, the American Institute of Electrical Engineers, and the American Society for Testing Materials, as well as that of the manufacturers and many purchasers, and offers a specification which is simple and effective and of decided value to the electrical industry as a whole.

Stranded Copper Cable Estimate of Production for the Electrical Industry[1]
Year 1937

Size B. & S.	Lb. per M ft.	No. feet	Pounds
6	81.05	71,000,000	5,754,550
5	102.2	111,000,000	11,344,200
4	128.9	62,000,000	7,991,800
3	162.5	81,000,000	13,162,500
2	204.9	79,000,000	16,187,100
1	258.4	17,000,000	4,392,800
1/0	325.7	43,000,000	14,005,100
2/0	410.9	49,000,000	20,134,100
3/0	518.1	6,000,000	3,108,600
4/0	653.3	34,000,000	22,212,200
CM			
250,000	771.9	4,500,000	3,473,550
300,000	926.3	7,500,000	6,947,250
350,000	1081	8,500,000	9,188,500
400,000	1235	3,500,000	4,322,500
450,000	1389	100,000	138,900
500,000	1544	16,500,000	25,476,000
550,000	1698	—	—
600,000	1853	2,000,000	3,706,000
650,000	2007	100,000	200,700
700,000	2161	200,000	432,200
750,000	2316	2,500,000	5,790,000
800,000	2470	1,000,000	2,470,000
850,000	2624	100,000	262,400
900,000	2779	300,000	833,700
1,000,000	3088	5,000,000	15,440,000
1,250,000	3859	400,000	1,543,600
1,500,000	4631	500,000	2,315,500
2,000,000	6175	1,500,000	9,262,500
	Total	607,200,000	210,096,250 (105,048 tons)

[1]Provided by the Statistical Department of the National Electrical Manufacturers Association and the Anaconda Wire and Cable Co.

New Improvements At Republic's Gadsden, Alabama, Plant



Inside the new bolt and nut factory recently put into operation at Republic Steel Corporation's Gadsden, Alabama, plant. With a total bolt-making capacity of 1,000 tons per month which makes it one of the largest in the south, the new factory is equipped to produce a complete line of building, carriage and machine bolts from 3/16th to 1-½ inches. ✦ ✦

IMPORTANT improvements representing an outlay of several million dollars have been made in the Republic Steel Corporation's Gadsden, Alabama, plant.

✦ ✦ ✦

THE improvements, being made in just about every department of the plant, include construction of two new open hearth furnaces, an ingot-mold yard and stripper building, installation of a bolt and nut factory, construction of a new 2-story office building and extensions to the sheet mill that increase its capacity from 6,000 to 9,000 tons per month. With recent completion of the first wing of the new bolt and nut factory, Republic enters the southern bolt-making field with one of the largest bolt factories in the south.

✦ ✦ ✦

THE two new open hearths are 150-ton furnaces, increasing the total open hearth ingot capacity of the plant from 28,000 to 50,000 tons per month. The open hearth stock yard was enlarged and necessary changes in the open hearth high line approach were made. A new 7½-ton floor charging machine was installed, also a new 75-ton hot metal crane over the charging floor.

✦ ✦ ✦

OVER-ALL extension of the open hearth building is 264 ft. The new ingot-mold yard and stripper building is 5 by 312 ft.

✦ ✦ ✦

ON the pit side of the open hearths, a new 210-ton crane was installed, also additional slag car equipment. Throughout the yards in and around the open hearth and stripper buildings, considerable incidental re-arrangement of railroad track had to be made.

✦ ✦ ✦

THE open hearth ladles, which have two stopper rigs for the pouring of two ingots at one time, have a capacity of 150 tons, the slag pot a capacity of 370 cubic feet. The stripper crane was moved from the soaking pit building to the new ingot mold building where the ingot stripping operation is now being done. There is also a new 15-ton crane in this building for such light crane work as the handling of hot tops.

With completion of two new 150-ton furnaces, Republic Steel has upped its total open hearth ingot capacity at the corporation's Gadsden, Alabama, plant from 28,000 to 50,000 tons per month. Here is one of the new open hearth ladles pouring two ingots at one time. ✦ ✦ ✦

✦ ✦ ✦

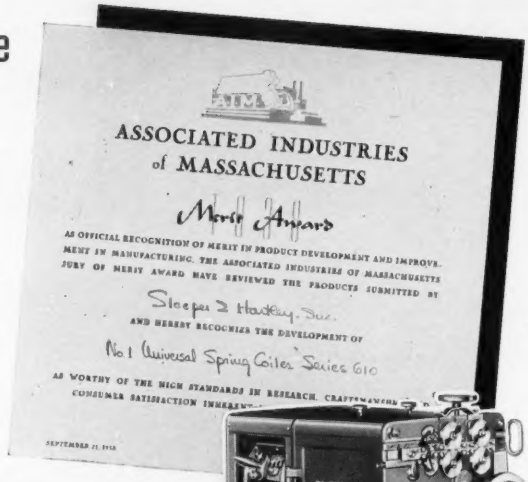
INSTALLATION of new equipment and improvements in the sheet mill which increased sheet capacity 50 per cent, made available a complete line of sheet mill products including black, blue, and galvanized sheets. The hot mill train was extended with the installation of a new 3-high roughing mill to replace one of the old 2-high stands, and the installation of two new 2-high finishing stands. Necessary feeder and catcher tables were added. The new hot mill motor drive is an 1800 horsepower gear unit.

✦ ✦ ✦

TWO additional pack-heating furnaces were added to feed the new 2-high mills. They are double-chamber type furnaces, each 55 ft. long. At the last hot mill stand a return conveyor was built to take packs from this mill directly to the back of the furnaces for the final pass.

(*Please turn to Page 182*)

There is SIGNIFICANCE in the fact that SLEEPER & HARTLEY, Inc. won TWO CERTIFICATES of MERIT during the year - - 1938


ASSOCIATED INDUSTRIES
of MASSACHUSETTS

Merit Award

AS OFFICIAL RECOGNITION OF MERIT IN PRODUCT DEVELOPMENT AND IMPROVEMENT IN MANUFACTURING, THE ASSOCIATED INDUSTRIES OF MASSACHUSETTS JURY OF MERIT AWARD HAVE REVIEWED THE PRODUCTS SUBMITTED BY

Sleeper & Hartley, Inc.

AND HEREBY RECOGNIZE THE DEVELOPMENT OF

No. 1 Universal Spring Coiler Series 610

AS WORTHY OF THE HIGH STANDARDS IN RESEARCH, CRAFTSMANSHIP, AND CONSUMER SATISFACTION INHERENT

SEPTEMBER 21, 1938

ASSOCIATED INDUSTRIES
of MASSACHUSETTS

Merit Award

AS OFFICIAL RECOGNITION OF MERIT IN PRODUCT DEVELOPMENT AND IMPROVEMENT IN MANUFACTURING, THE ASSOCIATED INDUSTRIES OF MASSACHUSETTS JURY OF MERIT AWARD HAVE REVIEWED THE PRODUCTS SUBMITTED BY

Sleeper & Hartley, Inc.

AND HEREBY RECOGNIZE THE DEVELOPMENT OF

Combination

BX Twisting & Armoring Machine

AS WORTHY OF THE HIGH STANDARDS IN RESEARCH, CRAFTSMANSHIP, AND CONSUMER SATISFACTION INHERENT IN MASSACHUSETTS INDUSTRY.

Roy L. Gilleau

GENERAL MANAGER

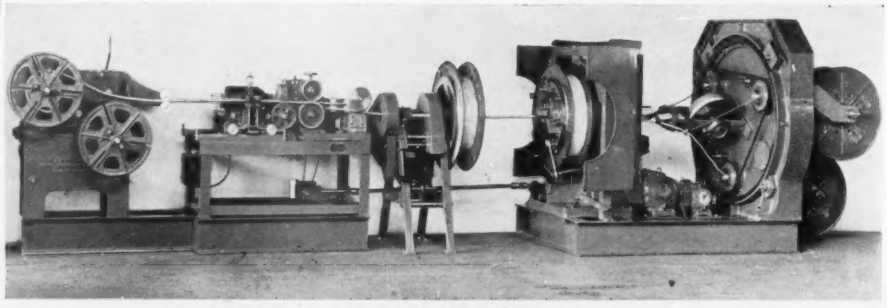
SEPTEMBER 21, 1938

The QUICK-CHANGE GEAR BOX decreases set-up time through the elimination of pick-off change gears.

CONTROLS for pitch, diameter and variable speed are accessibly extended outside machine. PRODUCTION with ACCURACY.

No. 1 UNIVERSAL SPRING COILER **Series 610**

1. STRANDS
2. WRAPS
3. COILS
4. SPOOLS
5. FLEXES
6. MEASURES
7. CUTS OFF
8. TAKES UP



CABLE ARMORING MACHINE Series 661

Wire-Working Machinery
Wire Mill Equipment

Sleeper & Hartley, Inc.
Designers and Builders
Worcester, Massachusetts

Stresses in Helical Compression Springs
Present Status of the Problem

By C. T. Edgerton,

Manager, Bureau of Statistics,
Crucible Steel Company of America, New York, N. Y.

Since Dr. Röver, in 1913, first formulated the modern theory of the stress distribution in a helical spring, including the effect of bar curvature, pitch angle, direct shear stress, etc., a number of investigators have treated the problem. Wahl, Göhner, Adams, Vogt, Perkins and Keysor have all presented interesting analyses. Most of these vary somewhat in the detailed method of treatment, but they all arrive at substantially the same result, in terms of the maximum fiber stress in the section. Wahl, in a notable series of experiments, demonstrated that these maximum stresses postulated by the theory are actually present in the spring.

Thus it would appear that we have a satisfactory working theory. But practical spring men feel that there must be something wrong; the theory, when applied to certain standard spring designs with very satisfactory service records, predict stresses which seem far too high to be compatible with good endurance in service. This feeling is supported by the results of a few endurance tests, which indicate rather clearly that the maximum stresses predicted by the theory, though undoubtedly present, do not correctly index the actual endurance.

In the author's opinion, all the evidence points to the conclusion that the problem of design stresses in helical springs is not one for the mathematician, but must be worked out in the laboratories, by actual experiment.

IT was as long ago as 1913 that **Röver** published an article (1)[2] in which was announced, for the first time, a first approximation to the modern theory of the stress in helical springs. Up to that time the **Reuleaux** formula (2) had been the universal standard; it assumed that the only stress present was pure torsion. **Röver's** theory recognized not only the torsional stress, but also the direct-shear stress, the bending stress due to the pitch angle, and the variation in torsional stress from point to point of the section, due to the curvature of the bar.

✦ ✦ ✦

RÖVER developed his theory in three steps. He first worked out an approximate correction factor for the maximum value of the stress augment due to the bar curvature, plus the direct-shear stress; the pitch angle was taken as zero. He then amplified this correction factor to include the bending stress due to the pitch angle. Both of these formulas are approximate, and both are based on the assumption that the center of torsional rotation coincides with the geometrical axis of the bar. This is incorrect, as the shear moments over the section would not be in statical equilibrium. The center of torsion is displaced a small amount toward the spring axis.

RÖVER'S third step was to develop a more exact but very complicated solution, based on elastic theory, for a particular value of the spring index. This development is therefore of value only as a check on his approximate formula. The latter gives a result differing by only 1 per cent from the more exact solution, for the numerical case examined.

✦ ✦ ✦

CONSIDERING the importance of **Röver's** theory, it is surprising that it attracted so little attention. It seems to have been practically unnoticed for 15 years, when **Wahl** made his experiments at the Westinghouse laboratories (3).

✦ ✦ ✦

THIS research of **Wahl's** was magnificently simple in conception and execution. He mounted a half coil of a spring in a testing machine, in such a way that the stress distribution accurately simulated that in the body coils of a complete helical spring, and measured the strains at the innermost helical element (the locus of maximum stress); then reduced these strains to corresponding shear stresses. He also took measurements at the outermost element (locus of minimum stress) and checked these with measurements on the outermost element of complete springs. Due to space limitations, it was impossible to check the complete springs at the innermost element.

✦ ✦ ✦

SUPPLEMENTING his experimental work, **Wahl** announced a revised stress formula. It takes into account the stress differentials due to bar curvature and to direct shear, but not the pitch angle. The correction for bar curvature recognizes the displacement of the center of torsion from the geometrical center of the bar, in accordance with curved-bar theory. Therefore **Wahl's** formula is presumably more accurate than **Röver's** first approximation. As to the experimental results, **Wahl** did not report any numerical figures; however, he did show a graphical plot of his results, together with the theoretical curve for the test springs based on his

[2] **Numbers in parentheses refer to the Bibliography at the end of the paper.**

Contributed by the A.S.M.E. Special Research Committee on Mechanical Springs for presentation at the Annual Meeting of The American Society of Mechanical Engineers, held in New York, N. Y., December 5-9, 1938.

[3] **"Analysis of Effect of Wire Curvature on Allowable Stresses in Helical Springs," by A. M. Wahl.**

✦ ✦ ✦

Table 1. Formulas used for comparing stresses in helical compression springs.

Author	Formula	Stress Components Included	Value of coefficient for C = 4
Reuleaux	$\frac{8PM}{\pi d^3}$	A	1.000
Rover (1)	$\frac{8PM}{\pi d^3}\left\{\frac{c}{c-1}+\frac{1}{4c}\right\}$	A-B-C	1.396
Rover (2)	$\frac{8PM}{\pi d^3}\left\{\frac{7}{13}\left[\frac{c}{c-\cos^2\phi}+\frac{\sin^2\phi}{4c}\right]\sin\phi+\sqrt{\left[\frac{c}{c-\cos^2\phi}+\frac{1+\sin^2\phi}{4c}\right]^2\cos^2\phi+\left[\frac{c}{c-\cos^2\phi}+\frac{\sin^2\phi}{4c}\right]^2\sin^2\phi}\right\}$	A-B-C-D-E	1.450
Modification of (2)	$\frac{8PM}{\pi d^3}\left\{\frac{7}{13}\left[\frac{c}{c-\cos^2\phi}+\frac{\sin^2\phi}{4c}\right]\sin\phi+\sqrt{\left[\frac{c}{c-\cos^2\phi}+\frac{1}{4c}\right]^2+\left[\frac{\sin\phi\cos\phi}{4c}\right]^2}\right\}$	A-B-C-D-E	1.450
Wahl	$\frac{8PM}{\pi d^3}\left\{\frac{4c-1}{4c-4}+\frac{0.615}{c}\right\}$	A-B-C	1.404
Adams	$\frac{8PM}{\pi d^3}\left\{\frac{d^3}{16K}\cdot\frac{d-2x}{M-d}\right\}C_1$ where $x=\frac{d}{4}\left\{2c-\frac{1}{c-\sqrt{c^2-1}}\right\}$ $K=\frac{d^2}{12}\left\{d\left(\frac{c^2+1}{\sqrt{c^2-1}}\right)+6x\right\}-\frac{M}{6}\left\{M^2\left[\frac{c^2}{\sqrt{c^2-1}}-1\right]+6x\left[M-x\right]\left[1-\sqrt{1-\frac{1}{c^2}}\right]\right\}$ C_1 is a factor to allow for effect of combined stresses.	Doubtful	abt. 1.44
for S_T Göhner (1)	$\frac{8PM}{\pi d^3}\left\{\frac{c}{c-\cos^2\phi}+\frac{\cos^2\phi}{4c}+\frac{\cos^4\phi}{16c^2}+\left[\frac{0.62\cos^2\phi}{c}+\frac{0.53\cos^4\phi}{c^2-c\cos^2\phi}\right]\tan^2\phi\right\}\cos\phi$	A-B-C	1.324
for S_B Göhner (1)	$\frac{16PM}{\pi d^3}\left\{1+\frac{0.87\cos^2\phi}{c}+\frac{0.64\cos^4\phi}{c^2-c\cos^2\phi}+\frac{1}{4c}\right\}\sin\phi$	D-E	1.324
Göhner (2) for S_T	$\frac{8PM}{\pi d^3}\left\{\frac{c}{c-\cos^2\phi}+\frac{\cos^2\phi}{4c}-\frac{\cos^4\phi}{8c^2}\right\}\cos\phi$	A-B-C	
Göhner (3) for S_T	$\frac{8PM}{\pi d^3}\left\{\frac{c}{c-\cos^2\phi}+\frac{\cos^2\phi}{4c}\right\}\cos\phi$	A-B-C	
for S_T Göhner (4)	$\frac{8PM}{\pi d^3}\left\{1+\frac{5}{4c}+\frac{7}{8c^2}+\frac{1}{c^3}\right\}\cos\phi$	A-B-C	1.326
for S_B Göhner (4)	$\frac{16PM}{\pi d^3}\left\{1+\frac{1.12}{c}+\frac{0.64}{c^2}\right\}\sin\phi$	D-E	1.326
Vogt	(for Compression Springs) $\frac{8PM}{\pi d^3}\left\{\frac{0.9875c}{c-1}\right\}$	A-B-C-D-E	1.317
Vogt	(for Extension Springs) $\frac{8PM}{\pi d^3}\left\{\frac{1.0875c}{c-1}\right\}$	A-B-C-D-E	1.450
for S_T Perkins	$\frac{8PM}{\pi d^3}\left\{\left[1-\frac{\sin^2\phi}{2}\right]\left[\frac{2c+1.1\cos^2\phi}{2c-1.4\cos^2\phi}+\frac{0.3\cos^4\phi}{c^2(c-\cos^2\phi)}\right]-\left[\frac{\sin^2\phi}{4}\right]\left[\frac{2c-\cos^2\phi}{c-\cos^2\phi}\right]\frac{1}{\cos\phi}\right\}$	A-B-C	1.320
for S_B Perkins	$\frac{8PM}{\pi d^3}\left\{\frac{\sin^2\phi}{2c}+\frac{2c^2-\cos^4\phi}{c(c-\cos^2\phi)}\right\}\sin\phi$	D-E-F	1.320

SYMBOL NOTATION FOR STRESS COMPONENTS INCLUDED.
A- Pure Torsional Stress
B- Correction for Bar Curvature
C- Direct Shear Stress
D- Bending Stress
E- Direct Tension or Compression
F- Secondary Shear Stress

formula. He ran the tests on two specimens, and as the theoretical stress was a few per cent greater than the experimental result on one, and a few per cent less on the other, we can consider that he got substantial agreement.

✦ ✦ ✦

ANOTHER interesting contribution to the subject was that of **Adams** (4), who developed an extremely complicated set of equations for the torsional stress. However, it is difficult to appraise accurately the value of **Adams'** work. The author himself states that "the results derived in the . . . analysis are rigorous." But the analysis is not given in full; in an editorial footnote it is stated that the integrations are very difficult and lengthy, and cannot be reproduced, but that they have been examined and checked. **Adams** gives his final result (a correction factor for the stress augment due to bar curvature) in three separate equations. Then he arbitrarily inserts in the equation another correction factor, representing the effect of direct-shear and bending stresses, and he names certain values for this factor, for various index values. He says he has "shown (this) elsewhere." His formula for displacement of the axis of torsion gives about the same numerical value as the form used by **Wahl**, for an index of 4. His final correction factors agree closely with **Wahl's** for very small and rather large index values; however, for intermediate values there is a difference of several per cent. Thus **Adams** was able to check **Wahl's** experimental results to about 1.25 per cent; **Wahl's** test springs were of index 3.

✦ ✦ ✦

THE next contribution we find is that of **Göhner.** In 1930 and 1931 **Göhner** published three articles developing the pure theory of the stress distribution in helical springs. In March, 1932, he published a fourth article (5) in which he announced a series of simplified formulas based on his earlier work and in convenient form for practical spring calculations. The stress formula is stated in four different forms, each successive form being a further simplification.

✦ ✦ ✦

IN the year following **Göhner's** work, **Vogt** (6) made some ingenious simplifications of the equations developed by **Röver** as his second step; as explained before, this step includes the corrections for bar curvature, direct shear, and pitch angle. Therefore **Vogt's** equations, like **Röver's,** involve the error of taking the center of torsion at the geometrical axis of the bar.

✦ ✦ ✦

VOGT makes the interesting suggestion that the stress equation be stated in terms of tensional stress instead of torsional, and in his own paper his equations are so stated. Probably something could be said on both sides of this

question, but a discussion of the subject does not come within the scope of the present paper.

✦ ✦ ✦

AT the December, 1933, meeting of the A.S.M.E., **Professor H. C. Perkins** of Cornell University presented a paper (7) in which he developed a very interesting set of equations. **Perkins** followed the method used by **Röver** in his accurate solution for a particular index value; but, he generalized the loading on the spring to cover a combination of an axial force and an axial couple, and he generalized his solution to cover any numerical value of index.

✦ ✦ ✦

IN the following year, **Professor Perkins** gave us a second paper, in which he gave stress equations for the case of an eccentrical loaded helical spring.

✦ ✦ ✦

IT is necessary to mention one other name. At the A.S.M.E. meeting in December, 1934 **Keysor** (8) gave us a discussion of the problem from a new standpoint. All the previous investigators had discussed a condition in which the stress distribution was the same in every section of the bar. **Keysor**, in considering the problem of the number of inactive coils, decided that any assumptions as to axial loading were not justified, and investigated the general case of a helical spring of standard end conformation compressed between two parallel plates. He found that the effective loading was in general nonaxial, the eccentricity varying with the spring index, the number of total coils, and the number of fractional coils. For certain combinations of these variables the eccentricity becomes zero.

✦ ✦ ✦

WHILE the Bibliography given with this paper is by no means complete, it probably covers the more important contributions to the subject. Now it will be interesting to look at the various formulas that have been mentioned, and compare the results they give.

✦ ✦ ✦

IN Table 1 are listed the formulas, their authors, the stress components accounted for by each, and the numerical value of the correction factor from each formula for an index value of 4. For ready comparison, all the formulas are reduced to a standard form, consisting of the **Reuleaux** formula times a correction factor, and a common notation is employed. The latter is

S_b = **maximum tension or compression stress (bending plus direct tension or compression)**
S_t = **maximum shear stress (torsion plus direct shear)**
S_c = **maximum combined stress, in terms of shear stress**
d = **diameter of spring bar**
M = **mean diameter of helix**
P = **applied load, compressing the spring**
c = **spring index** = M/d
ϕ = **pitch angle**

✦ ✦ ✦

IN order to calculate the numerical values of the correction factors, it is necessary, where the formulas involve the pitch angle ϕ, to assign a particular value therefor. As the fiber stress is a maximum when the spring is completely compressed or solid, and this solid stress is usually the starting point for design calculations, it seems logical to use as typical the value of the pitch angle when the spring is solid. This value is

$$\phi = \tan^{-1} d/\pi M = \tan^{-1} 1/\pi c \quad [1]$$

✦ ✦ ✦

LISTED first in Table 1 is the **Reuleaux** formula, which probably needs no introduction to engineers. It is the well known

$$S = \frac{8PM}{\pi d^3} \quad [2]$$

in which only pure torsional stress is considered.

✦ ✦ ✦

NEXT come the several **Röver** formulas. It is easy to see how **Röver** arrived at his first and simplest form. Neglecting the pitch angle and the displacement of the axis of torsion, he assumed that the stress augment at any point on the periphery of the bar varied inversely as its distance from the cylindrical axis; its maximum value, at the innermost point of the periphery, being

$$S = S_0 \frac{M/2}{(M-d)/2} \quad [3]$$

where S_0 is the mean stress as given by the **Reuleaux** formula. The fractional term obviously reduces to the first term in the **Röver** equation $c/(c-1)$. For the direct shear at the innermost point on the cross section, **Röver** wrote $(P/2)/(\pi d^2/4)$, which, when the term $8PM/\pi d^3$ is factored out, becomes the second term in his correction factor, that is, $\frac{1}{4}c$.

✦ ✦ ✦

RÖVER then modifies his formula to give effect to the influence of the pitch angle. Space will not permit a detailed description of the method used. The two formulas developed, for torsion-shear and bending-tension stresses, respectively, are shown in formulas 4 and 5 at the bottom of this page.

✦ ✦ ✦

RÖVER then combines these in the classic form (taking **Poisson's** ratio as $m = 3\frac{1}{3}$)

$$S_c = 0.35S_b + 0.65\sqrt{(S_b^2 + 4S_t^2)} \quad [6]$$

Substituting the two values, and rewriting in terms of torsion-shear stress, we obtain the third **Röver** formula given in Table 1.

✦ ✦ ✦

THIS formula can be rigidly transformed into the fourth form. The latter can be further simplified very greatly, with only very minor losses in accuracy. However, a discussion of these does not lie within the scope of this paper.

✦ ✦ ✦

REFERENCE to the last column in Table 1 shows that for index 4 the value of the correction

$$S_t = \frac{8PM}{\pi d^3}\left(\frac{c}{c-\cos^2\phi} + \frac{1+\sin^2\phi}{4c}\right)\cos\phi \quad [4]$$

$$S_b = \frac{16PM}{\pi d^3}\left(\frac{c}{c-\cos^2\phi} + \frac{\sin^2\phi}{4c}\right)\sin\phi \quad [5]$$

coefficient has been increased about 4 per cent by including the effect of the pitch angle.

✦ ✦ ✦

GOING now to **Wahl's** formula, this is quite widely known and used, and a full description of the derivation is readily available; therefore, only a brief statement is necessary here. **Wahl** used for the displacement of the axis of rotation the well-known approximation $d^2/8M$. He then found that the **Röver** factor for torsional stress augment, that is $c/(c-1)$, must be multiplied by another factor

$$\frac{(d/2) - (d^2/8M)}{d/2}$$

and becomes

$$\left(\frac{c}{c-1}\right)\left[\frac{(d/2) - (d^2/8M)}{d/2}\right] = \left(\frac{c}{c-1}\right)\left(1 - \frac{1}{4c}\right) = \frac{4c-1}{4c-4} \quad \text{.....[7]}$$

FOR the direct-shear stress at the innermost point of the cross section, **Wahl** used the expression $1.23P/(\pi d^2/4)$, and his complete correction factor becomes

$$\frac{4c-1}{4c-4} + \frac{0.615}{c}$$

✦ ✦ ✦

IT may be noted that the first term of **Wahl's** correction factor yields considerably lower numerical values than **Röver's** and the second term gives higher values. The two values for the complete expressions, as shown in Table 1 differ by less than 1 per cent for $c = 4$.

✦ ✦ ✦

WAHL made no allowance for the pitch angle, stating that "it can be shown that a change in slope from zero to 10 deg. does not change the maximum shear stress more than a few per cent."

✦ ✦ ✦

IT is impossible to discuss **Adams'** formulas in detail for the reasons already given. A glance at Table 1 will reveal their complex character. As one of the terms in the final equation is an arbitrary constant, it was necessary to read off the representative numerical value of the correction factor, for index 4, from **Adams'** graphic chart. As the latter was too small to serve this purpose properly, the tabulated value is only approximate.

✦ ✦ ✦

GÖHNER'S equations are very interesting. In their simplified forms they are quite easy to manipulate, and calculations for several index values show that for "solid" pitch angles the error in these simplified forms is trifling. This is illustrated by the two values given in Table I.

✦ ✦ ✦

NEXT we come to **Vogt's** equations. In his simplification of the **Röver** formulas, **Vogt** wrote the equation for combined stress

$$S_c = \pm 0.36S_b + 0.64\sqrt{(S_b^2 + 4S_t^2)} \quad \text{.....[8]}$$

with the double sign for the first term, and he said that the plus sign applied to extension springs and the minus sign to compression springs.

✦ ✦ ✦

THIS procedure seems to be quite correct. In a compression spring, the bending component acts to bend the bar inward (in the direction of the curvature), and the resultant stress at the innermost fiber of the section is compressive. Also the $P \sin\phi$ component of the direct load is obviously a compressive force. According to the authorities, for combined torsion and compression stresses the equation must be written with a minus sign for the first term.

✦ ✦ ✦

RÖVER ignored this distinction; in combining his own formulas he write the result as in Table 1. Therefore, while **Vogt's** extension spring formula agrees with **Röver's,** his compression-spring formula gives a value about 10 per cent lower. Apparently **Adams** missed this point also. **Göhner** did not give a combined form for his own equations; in working out the values given in Table 1 **Vogt's** practice was followed.

✦ ✦ ✦

PERKINS' equations are quite interesting, as their accuracy is probably of a very high order. As already stated, **Perkins** followed **Röver's** method, except that he generalized it to cover any value of the index, instead of one particular value. He found that a "secondary shear stress" accompanies the bending, opposing the stress in torsion. However, its magnitude is very small.

✦ ✦ ✦

THE final equations for torsion-shear and bending-tension stresses are each stated in several successive steps, like those of **Adams,** however, **Perkins'** equations can be combined quite readily into the forms given in Table 1. Consolidation of these two into a single equation for the combined stress would yield a rather complicated expression, which is therefore omitted; for an index value of 4 the combined stress coefficient is 1.320, substantially the same as given by the **Göhner** and **Vogt** formulas.

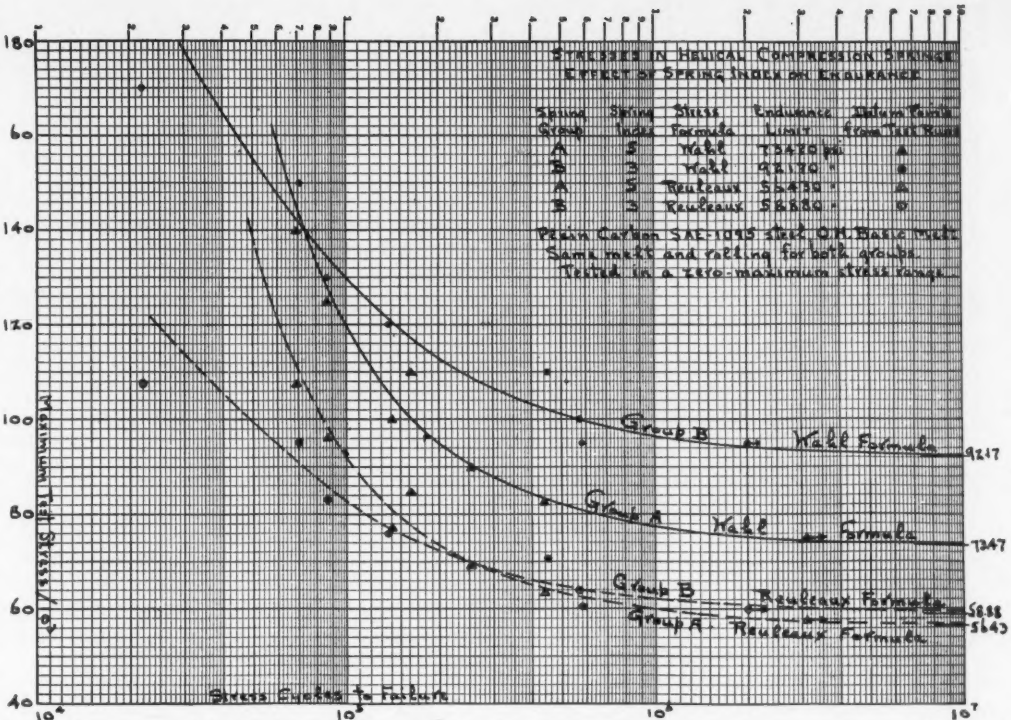
✦ ✦ ✦

PERKINS' equations gave effect to an axial couple as well as an axial force; but in order to make his formulas comparative with the others in Table I, the terms involving the axial couple have been omitted.

✦ ✦ ✦

FINALLY, we have **Keysor's** paper, dealing primarily with stress augments due to the eccentricity of the effective loading. **Keysor's** complete analysis is not available at the present writing, and in any event there would be no comparison between his formula and those already dealt with. **Keysor** used **Adams'** correction coefficient for bar curvature, direct shear, etc., inserting a symbol in his formula to represent them.

BUT it should be carefully noted that **Keysor's** analysis predicts a stress augment, due to eccentricity of loading alone, of as much as 28 per cent in certain designs (springs of very few total coils), and that in the outside coil of the standard A.A. R. freight-car bolster spring this augment is about 8 per cent, superimposed on the stress augments already discussed. Some experimental tests have been made, and a more elaborate research is now in progress, the results from which so far seem to confirm **Keysor's** theory.


Stresses in Helical Compression Springs
Effect of Spring Index on Endurance
Group B — Wahl Formula
Group A — Wahl Formula
Group B — Reuleaux Formula
Group A — Reuleaux Formula
Stress Cycles to Failure
Fig. 1. Stresses in helical compression springs showing the effect of spring index on endurance.

✦ ✦ ✦

FROM the comparisons given in Table 1, we might reasonably conclude that we have a very satisfactory theory covering our stress problem. Now let us look for a moment at the practical aspect. In the ten years since **Wahl** published the results of his research, these results have become quite generally known to spring engineers and designers. While they are coming more and more into use, many practical spring men still regard them with a certain amount of skepticism. It is necessary to inquire into the reasons for this attitude.

✦ ✦ ✦

WHAT these practical men tell us is, briefly, that our correction factors, when applied to certain widely used spring designs, indicate stresses that look rather absurd. Consider as an example, the outer coil unit of the standard A.A.R. freight-car bolster spring. Literally millions of these springs are riding American freight cars today. The maximum fiber stress at solid height, by the **Reuleaux** formula, is about 92,000 lb. per sq. in. The correction coefficient from **Wahl's** formula, less about 4¼ per cent for the effect of the pitch angle, is about 1.4, making the maximum stress 129,000 lb. per sq. in. If **Keysor's** theory be correct, we must now add to this about 8 per cent for load eccentricity, and we arrive at a stress of about 140,000 lb. per sq. in. torsion. This is well above the usual yield strength of the material.

✦ ✦ ✦

IT is true that these springs rarely or never go solid in service, but they will frequently come close to it. Yet, if made under reasonably good manufacturing conditions, they will give reasonably good service. There are other spring designs in common use, in which stress conditions are more extreme.

✦ ✦ ✦

THE A.S.M.E. Special Research Committee on Mechanical Springs felt that this practical argument merited some investigation. Here we must distinguish carefully between the intrinsic correctness of the **Röver-Wahl** theory, and its practical application to spring design. There is no doubt that the maximum stresses predicted by the theory are actually present in the spring; **Wahl's** experimental work proved that beyond any reasonable doubt. The real question is: Are these the critical stresses which index the life of the spring in service, or in an endurance test? Only the test itself can furnish the answer to this question.

✦ ✦ ✦

ACCORDINGLY the Committee arranged, in connection with its extensive fatigue-test program at Wright Field, to have two groups of springs made up from the same rolling and heat of steel, and otherwise alike in every respect except as to the spring index and related dimensions; one group was of index 5 and the other of index 3. The answer we want is a formula for maximum fiber stress, which, when applied to the results of the fatigue tests, will indicate the same endurance limit for both groups.

THE test results are shown graphicallv in Fig. 1. Datum points for the individual runs are plotted in duplicate, with stresses calculated from the **Reuleaux** formula and alternatively with the **Wahl** correction factor. Probable *S-N* curves are plotted for each of the groups, likewise in duplicate. These curves were calculated from the test data by statistical methods, based on the assumption that the *S-N* curve for ferrous metals is of the form

$$(N - a)\ (S - b) = k \quad \text{.....[9]}$$

and that the value of b can be interpreted as the endurance limit. The correlation between the test data and the curves as plotted is quite good for both groups.

✦ ✦ ✦

A STUDY of Fig. 1 discloses a rather puzzling state of affairs. The two **Wahl** curves intersect at a rather high stress. Springs in this and higher stress regions are given a quite severe "cold setting" in manufacture, and a possible interpretation of the results might be that under these conditions the springs are very sensitive to local stress augments, and perhaps that they are being subjected to augments not provided for in the **Wahl** correction factor, such as eccentricity of loading and distortion occasioned by the cold setting; there are several possibilities. As the stress is reduced the two **Wahl** graphs diverge rapidly, and give predicted endurance limits of 92,170 lb. per sq. in. for group B (index 3) and 73,470 lb. per sq. in. for group A (index 5).

✦ ✦ ✦

FOR the **Reuleaux** curves the situation is reversed. They are far apart at high stresses, converge rapidly as the stress is reduced, and the endurance limits are 58,880 and 56,430 lb. per sq. in., respectively. The apparent conclusion is that for moderately stressed springs local stress augments have little or no effect on endurance. This does not seem quite reasonable, but we can find nothing wrong with the test procedure and data. Further tests along the same lines are projected.

✦ ✦ ✦

WE then got **F. P. Zimmerli** interested in the problem, and he ran some tests on cold-wound wire springs of different index values. The results are given in Table 2, with an attempt at an analysis thereof.

✦ ✦ ✦

THE revised correction factors in Table 2 are coefficients, the decimal portions of which have been reduced by a fixed percentage from those of the corresponding **Wahl** factors. The fixed percentage was established by cut and try, the object being to arrive at a set of revised endurance limits for the various springs which would show a minimum systematic deviation from a mean. The percentage arrived at was 45 per cent. So we might state, as a hypothesis for discussion, that the effective maximum fiber stress in a helical spring is obtained by using a correction factor, the decimal portion of which is 55 per cent of the decimal portion of the **Wahl** factor.

✦ ✦ ✦

MR. WAHL calls this 55 per cent the "sensitivity index," and he attacks the problem along a line of argument, quite different to the foregoing, in a paper[3] being presented coincidentally with this one. He has given a good deal of time and thought to the subject, and what he has to say will be more pertinent than any theory the present writer is able to offer at the moment.

✦ ✦ ✦

BUT at least it seems obvious that our theory of stress in helical compression springs, despite the great amount of work that has been done on it and the very consistent results of the mathematicians, will have to be drastically modified to check with what we find in the experimental laboratory, and in actual spring service.

✦ ✦ ✦

HERE the author pauses, somewhat perplexed even to suggest a promising line of attack. Consider for a moment the intricate stress pattern in a helical spring. It includes:

Pure torsional stress.
Direct shear stress.
Bending stress.
Direct tensile or compressive stress.
A stress increment or decrement, nonsymmetrical with the bar axis, due to curvature of the bar.
A stress increment or decrement, nonsymmetrical with respect to the cylindrical axis, due to eccentricity of the effective loading.
In springs which have been cold set, entrapped stresses, of which little is known.
Possibly some kind of stress augment about two turns from the tip of the bar. Endurance-test failures show a tendency to localize in this region. This augment may be related to the load eccentricity.

✦ ✦ ✦

AT the Committee meeting last December, **Dr. A. W. deForest** remarked to the author that in view of the complex stresses present in a helical spring, it seemed hopeless to expect to solve them. Perhaps the best answer is that we can reasonably expect to find a definite consistency in the stress pattern. The proportions of a helical spring can only vary in a very limited number of ways, therefore, our stress pattern should only vary in a correspondingly limited number of ways. This means that while we may never attain to full understanding of the absolute stresses present, we should be able to find out a great deal about the relative stresses.

(*Please turn to Page 177*)

TABLE 2 TEST RESULTS ON COLD-WOUND WIRE SPRINGS

Spring	Index	Wahl correction factor	Endurance limit, Wahl formula	Endurance limit, Reuleaux	Revised correction factor	Revised endurance limit
A	3.5	1.476	100×10^3	67.75×10^3	1.262	85.50×10^3
B	4.55	1.346	94×10^3	69.84×10^3	1.190	83.11×10^3
C	7.00	1.213	93×10^3	76.67×10^3	1.117	85.64×10^3
D	9.10	1.161	91×10^3	78.38×10^3	1.089	85.36×10^3
E	11.90	1.121	90×10^3	80.29×10^3	1.067	85.67×10^3

Improved Continuous Insulating Equipment

By John R. Stricklen,

Vice President,
National Rubber Machinery Company, Akron, Ohio

The National Rubber Machinery Co. has recently built several continuous wire insulating units which differ mechanically in many important respects from the conventional design. The principal features of this equipment and the reasons for their adoption are discussed in this article. ✦

IN the process of continuously vulcanizing rubber covered wire, the extruded product passes directly from the die of the extruding machine into a vulcanizing tube, filled with steam, under pressure. The length of the tube, the steam pressure, the wire speed and the composition of the compound are all selected so that the time required for the wire to traverse the tube is sufficient to permit thorough vulcanization. The vulcanized product then leaves the tube through an exhaust seal, is cooled, and re-reeled.

✦ ✦ ✦

IN the usual mechanical arrangement, the vulcanized wire returns above the top of the tube to the tubing end of the machine for re-reeling. The tubing machine and the takeup are both driven by one motor through a compactly designed mechanical drive erected at floor level. This arrangement has a number of advantages over any other possible arrangement, likewise several disadvantages.

✦ ✦ ✦

IT will be obvious, for example, that in the usual arrangement the floor space beneath the vulcanizing tubes can be used only for storage purposes. However, this space can be made available for manufacturing facilities if the tubes are depressed below floor level or raised to a reasonable height above floor level. If either of these two alternative arrangements is adopted, it is not necessary to return the finished wire to the tubing machine for re-reeling, and the takeup units must be located remotely from the tuber ing, and the takeup units may be problem of providing a satisfactory takeup drive for remote re-reeling is the first consideration in any plan for the better utilization of space.

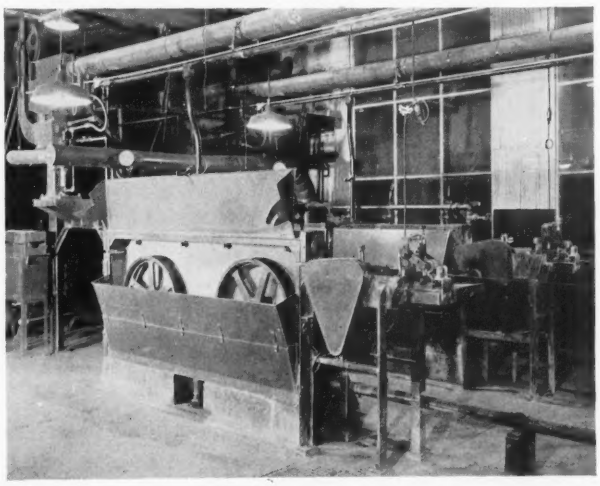


Fig. 1. Double Capstan Combined with Improved Type of Drive to Provide Improved Cooling Method. ✦ ✦ ✦

✦ ✦ ✦

THE ideal drive for this application is one involving no mechanical tie and no tension device but which has all the characteristics of a perfect mechanical drive, that is, a drive which will reproduce in the takeup mechanism precisely the same motion that would result from connecting it, without backlash, directly to the tuber. Such a drive can be obtained by connecting two specially designed wound rotor motors together electrically and giving to one, called the transmitter motor, the required motion mechanically for transmission to the second, called the receiver. This type of drive was adopted for the new units.

✦ ✦ ✦

IF the motors are selected so that the inertia and friction loads are within their torque capabilities, then the receiver follows the motion of the transmitter exactly except for a negligible amount of "electrical backlash." Since this drive had not been installed on a continuous vulcanizing machine, a careful and thorough analysis was made of every load factor, including friction and the inertia effect of supply and takeup reels and other rotating parts. The result of the analysis indicated that for the particular motors selected no change in wire diameter would be produced by any probable load condition. That conclusion was later verified by experience with the actual drive.

✦ ✦ ✦

WITH this improved type of drive it is necessary to provide improved cooling means. This was accomplished by means of the

Editor's Note: This process is known as the Western Electric Continuous Vulcanizing Process and is covered by patents owned by the Western Electric Company, Incorporated.

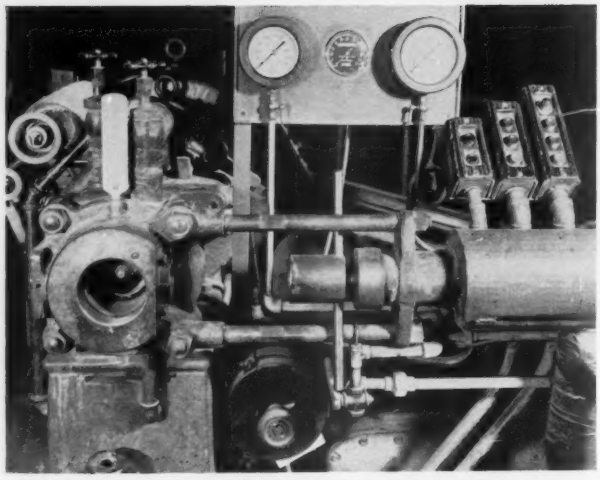


Fig. 2. New Type of Splice Box.

Fig. 3. Means for Close Control Over Takeup Tension.

double capstan shown in Figure 1. This capstan, which is driven by the receiver motor, and all important related parts of the takeup unit, are mounted on anti-friction bearings to insure a minimum friction load. The design of the capstan anticipated the possibility of tangles, consequently all details, including auxiliary guide sheave supports and the distributor roll and its supports were designed to break the largest conductor which will be run on the machine, without exceeding safe stress and deflection limits.

✦ ✦ ✦

WHILE the questions of floor space and cooling were of primary importance in the development of this equipment, a number of general improvements have been incorporated in its design. They include a new type of splice box, Figure 2, means for close control over takeup tension, Figure 3, improved wire straightener, Figure 4, improved supply and takeup stands, Figures 5 and 3, and a well designed electrical control system, for insuring smooth acceleration and deceleration. These and other improvements were incorporated primarily for the purpose of insuring a high and uniform quality of product.

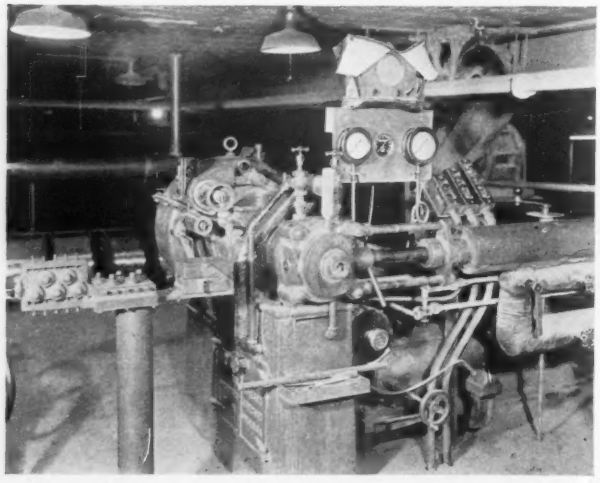


Fig. 4. Improved Wire Straightener.

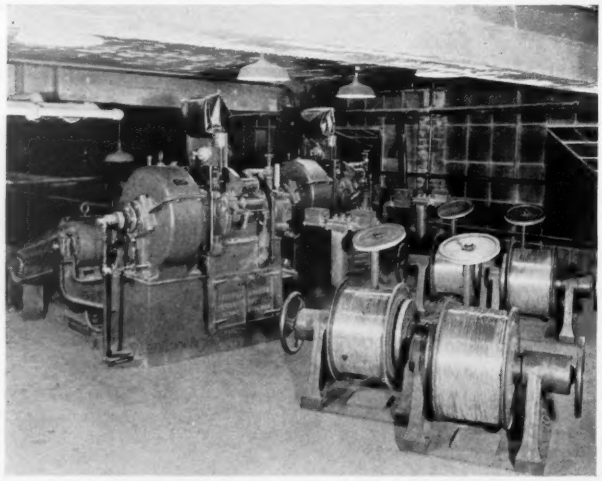


Fig. 5. Improved Supply and Takeup Stands, Showing Electrical Control System for Insuring Smooth Acceleration and Deceleration.

The Worcester Regional Meeting of the Wire Association
Will Be Held At
WORCESTER, MASS., TUESDAY, APRIL 25th, 1939.
Wire Association Headquarters Will Be At Hotel Bancroft.
Inspection of Plant of The Norton Company
Interesting Papers and Discussions At Meeting
MAKE YOUR PLANS NOW TO JOIN IN THIS ACTIVITY

Exports and Imports of Wire

Exports of Iron and Steel Wire Products in Dec. 1938 and Dec. 1937 (in gross tons)

	DEC. 1938	NOV. 1938	DEC. 1937
Wire rods	307	1,600	2,811
Strip steel	6,807	5,877	8,371
Plain, black or galvanized iron or steel wire	4,607	5,881	3,183
Barbed wire and woven wire fencing	3,318	3,954	1,987
Woven wire screen cloth	111	110	106
Wire rope	342	278	529
Insulated iron or steel wire and cable—see analysis below			
Other wire and manufactures	726	818	520
Wire nails	2,599	2,122	1,678
Tacks	25	21	33
Other nails, including staples	188	467	327
Bolts, machine screws, nuts, rivets and washers	749	665	744
Total, these 11 classifications	19,779	21,793	20,289

Imports of Iron and Steel Wire Into the United States (in gross tons)

Concrete Reinforcement Bars	317	114	85
Hollow bar and drill steel	48	133	191
Wire rods	480	803	634
Barbed wire	738	559	589
Round iron and steel wire	264	252	484
Telephone and telegraph wire	11	7	17
Flat wire and strip steel	295	302	262
Wire rope and strand	114	157	232
Other wire	73	208	65
Hoops and bands	2,143	1,658	1,878
Nails, tacks and staples	677	842	432
Bolts, nuts and rivets	5	21	9
Total, these 12 classifications	4,165	5,056	4,878

Exports of Insulated Wire and Cable, December, 1938

	Foreign		To U. S. Possessions	
	Pounds	Dollars	Pounds	Dollars
Rubber covered wire	475,976	$116,026	104,517	$32,279
Weatherproof wire	166,192	23,697	15,686	2,701
Other insulated copper wire	406,615	100,494	203,928	31,116
Nickel-chrome electric resistance wire	51,795	48,442	.....	.....
Total, these 4 classifications	1,100,578	$288,659	324,131	$66,096

Exports

DECEMBER iron and steel exports—chiefly as the result of reduced shipments of pig iron and skelp—at 166,404 tons ($11,506,216) were 29,752 tons ($16,501) below the November trade. A year ago—in December, 1937—exports of iron and steel products totaled 206,635 tons valued at $20,720,150.

✦ ✦ ✦

NON-ALLOY black steel sheets —23,428 tons—was the first commodity in point of tonnage in the December export trade—Russia (6,645 tons), Canada (4,046 tons), the United Kingdom (3,794 tons), and Australia (2,822 tons) being the leading markets. Japan (17,032 tons), China (1,750 tons), and Sweden (1,000 tons) were the principal outlets for pig iron (20,622 tons), while the Netherlands (9,958 tons) and Sweden (4,112 tons) were the principal buyers of non-alloy "other" plate (19,926 tons). Shipments of tin plate and taggers' tin (10,578 tons) as usual went to a large number of markets including Brazil (1,574 tons), the Netherlands (1,404 tons), and British India (999 tons). Japan (9,587 tons) was easily the principal market for non-alloy ingots (10,197 tons).

✦ ✦ ✦

WITH purchases totaling 30,075 tons Japan was the leading foreign market for American iron and steel in December, including in her purchases 17,032 tons of pig iron and 9,587 tons of steel ingots, blooms, billets and slabs. Canada, first market in November, ranked second in the December trade, taking 23,320 tons of a wide variety of iron and steel products of which the chief, in point of tonnage were, skelp, (7,438 tons), black, non-alloy steel sheets (4,046 tons), hot-rolled, non-alloy strip (2,504 tons), and plain structural shapes (1,696 tons).

✦ ✦ ✦

THE trade with the Netherlands —12,131 tons — was marked by the shipment of 9,958 tons of "other" plate, 1,739 tons of black, non-alloy steel sheets, and 1,404 tons of tin plate. Heavy rails — 2,529 tons — featured the 11,878-ton December trade with Brazil, 1,739 tons of black, non-alloy steel sheets and 1,574 tons of tin plate also being important factors in the total noted. The Philippine Islands was the destination of 10,784 tons of American iron and steel during the month, this total including 2,525 tons of galvanized steel sheets, 2,084 tons of "other" non-alloy steel bars and 1,306 tons of wire nails.

✦ ✦ ✦

BLACK, non-alloy steel sheets— 6,645 tons — was the largest item in the 8,251-ton trade with the U.S.S.R., while 3,794 tons of these same sheets featured the 6,301-ton trade with the United Kingdom. Sweden purchased 4,112 tons of "other" non-alloy, non-fabricated plate and 1,000 tons of pig iron as part of her 6,057 ton December total.

✦ ✦ ✦

SHIPMENTS of scrap in December — 323,691 tons valued at $4,797,676—were well above the November 1938 trade of 273,440 tons* valued at $4,000,084. Exports in December 1937 amounted to 319,771 tons and were valued at $5,701,466. *(Revised figure)

✦ ✦ ✦

EXPORTS of iron and steel scrap totaled 321,261 tons ($4,708,803) and included 177,381 tons dispatched to Japan, 72,689 tons which went to Italy, 21,791 tons shipped to the Netherlands, 15,729 tons which found markets

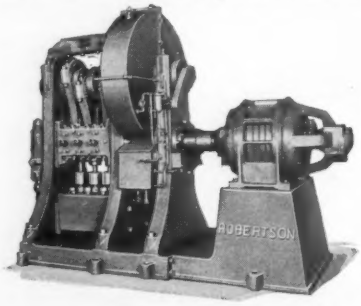
(Please turn to Page 174)

Diogenes came out of the barrel

When he saw the new ROBERTSON HYDRAULIC PUMP Bulletin — a clear, unembroidered and fact-packed presentation of the many advantages engineered and built into this world-used Pump.

And, every man who is interested in improved pump performance and in more operating savings will appreciate this Bulletin as well.

In condensed, easily readable form are the things you need to know to make accurate, safe decision as to the pump you install—a complete, uninflated description of the advantages we offer. Your copy is free; there's no obligation; the coupon brings it to you.



JOHN ROBERTSON CO., INC.
125-137 Water St. Brooklyn, N. Y.

Without obligation, send me your New Pump Bulletin.

FREE! New Robertson Pump Bulletin

Name ..... Title .....

Company ..... Address .....

W. & W. 3-39

Exports and Imports of Wire

(*Continued from Page 173*)

in Canada, and 13,570 tons which moved to German consumers.

✦ ✦ ✦

THE December scrap exports total also included 1,149 tons of tin plate scrap (all of which went to Japan). A total of 730 tons of tin plate circles, cobbles, strips, etc., also was exported—434 tons to China and 230 tons to Japan—while 551 tons of waste-waste tin plate also left the country including shipments of 350 tons to the Netherlands and 157 tons to China.

✦ ✦ ✦

Imports

DECEMBER imports at 22,248 tons valued at $1,405,704 were 630 tons smaller than in November, but were valued at $3,483 more than in that month. Receipts in December 1937 totaled 25,104 tons valued at $1,568,033.

✦ ✦ ✦

BELGIUM was the chief supplier in the December trade with shipments totaling 6,273 tons of which 2,840 tons was structural shapes, 1,477 tons was "other hoops", and 1,048 tons, "bars whether solid or hollow." Imports from Germany totaled 4,356 tons in increasing 1,073 tons over November—"other pipe", 1,346 tons, and nails, 465 tons, were the leading items. Canadian December shipments at 3,285 tons included 2,437 tons of spiegeleisen and 790 tons of pig iron, while of the Netherlands' total of 2,614 tons, 2,422 tons was ferromanganese.

✦ ✦ ✦

DECREASING 630 tons in quantity but increasing $3,483 in value, December imports of iron and steel were virtually unchanged from those of November. The months' leading product was ferromanganese imports of which rose to 4,333 tons from November's 2,571 tons. Receipts of structural shapes decreased only 177 tons to total 3,621 tons, while the trade in spiegeleisen was down 2,616 tons to only 2,440 tons. Slight gains were recorded by "other hoops", "bars whether solid or hollow", and "other pipe" in totaling 2,143 tons, 1,854 tons, and

1,729 tons, respectively, in December. The trade in pig iron was off 256 tons at 1,237 tons, according to these same figures.

✦ ✦ ✦

DECEMBER scrap imports totaled 6,519 tons valued at $76,649 — a sharp increase over both the November trade—4,749 tons valued at $50,789—and that of December 1937—688 tons valued at $13,186. Canada supplied all but 11 tons of the December 1938 total.

✦ ✦ ✦

CARD CLOTHING receipts totaled 13,716 square feet valued at $21,568 against 19,662 square feet valued at $30,978, and came from the United Kingdom (13,416 square feet at $20,860), Belgium (150 square feet valued at $387) and Switzerland (150 square feet valued at $321).

✦ ✦ ✦

RECEIPTS OF WIRE HEDDLES totaled 1,029,000 pieces, supplied by Germany (923,000 pieces) and France (106,000 pieces).

✦ ✦ ✦

A TRADE of 31,231 square feet valued at $5,986 resulted in WIRE CLOTH AND SCREENING against 34,829 square feet valued at $6,864, and came chiefly from the Netherlands (13,761 square feet); Germany (8,903 square feet) and Canada (6,267 square feet).

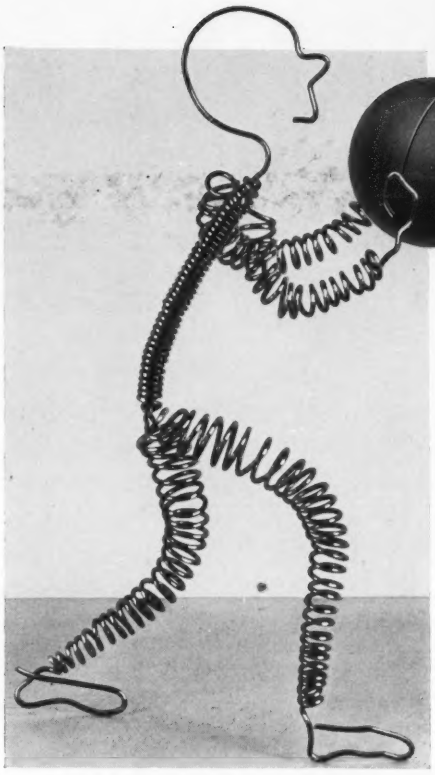
✦ ✦ ✦

FOURDRINIER AND OTHER PAPER-MAKING WIRE totaled 24,223 square feet, supplied by France (14,699 square feet) and Germany (9,524 square feet).

✦ ✦ ✦

RECEIPTS OF WIRE FENCING AND NETTING, galvanized before weaving, amounted to nothing. Of that galvanized after weaving, the total was 2,167,500 square feet valued at $13,458 against 1,099,252 square feet valued at $5,405 and came from Germany (1,395,000 square feet); Belgium (450,000 square feet) and the Netherlands (322,500 square feet).

(*Please turn to Page 176*)



Wire that'll Score for YOU!

Here's wire with speed . . . strength . . . toughness. Has an uncanny ability to slip smoothly through your machines and score heavily against delays, breaks, rejections and sluggish production. Keystone wire is an unusual performer because it is specially made to your requirements. There are many standard types and finishes in stock, too—all with the notable uniformity that marks any wire supplied by Keystone. Pass to us—we'll shoot the information.

SAMSON SPRING WIRE
REG. U.S. PAT. OFF.
KEYSTONE STEEL & WIRE CO. PEORIA, ILL.

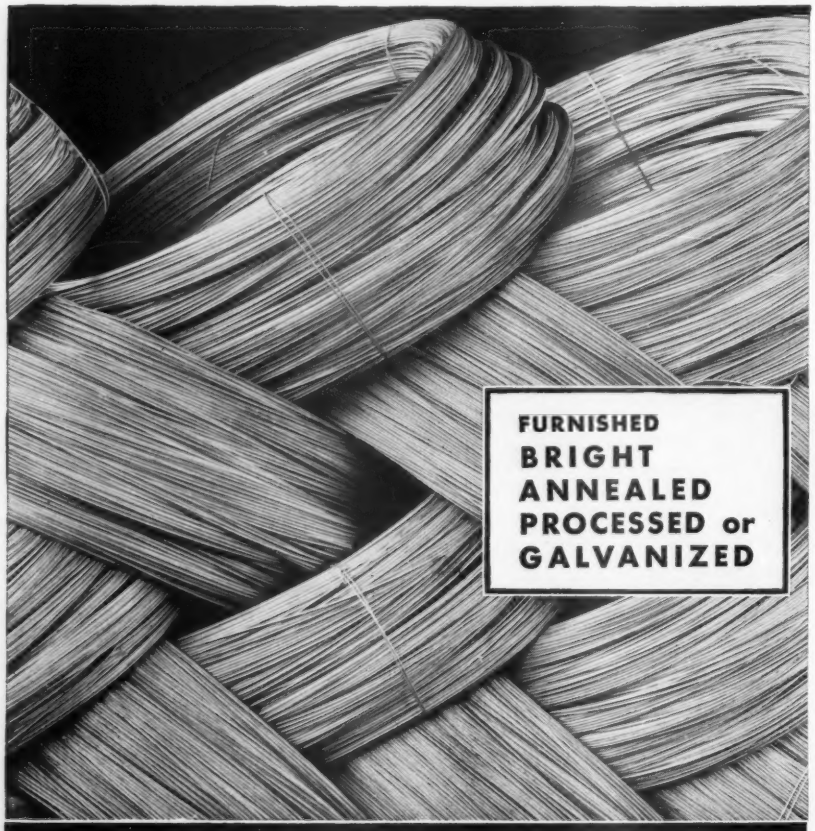
HIGH CARBON
or
LOW CARBON

Bright . . . Tinned
Coppered
Annealed
Galvanized

KEYSTONE
STEEL & WIRE CO., Dept. W, PEORIA, ILL.

CONTINENTAL
OPEN HEARTH
STEEL WIRE

Made in standard commercial grades, copper bearing, or Konik Metal. Sizes range from 23 gauge to 5/8 inch, and can be shipped in coils or straightened and cut. Is especially adapted to all types of manufacturing needs and can be supplied in special analyses to meet the most exacting specifications. Konik Metal is especially recommended for case hardening. All inquiries receive the careful attention of our well equipped and experienced metallurgical department. Write us about your needs — no obligation, of course.



CONTINENTAL STEEL CORPORATION
KOKOMO, INDIANA

Manufacturers of Billets, Rods, Wire, Barbed Wire, Nails; Lawn, Chain-Link, Diamond Mesh, Farm and Poultry Fence; Gates; Black, Galvanized, Galvannealed and Special Coated Sheets; Galvanized Roofing; also "Seal of Quality" Roofing and Kindred Products.

Exports and Imports of Wire

(*Continued from Page 175*)

EXPORTS of iron and steel wood screws during December, 1938 totaled 45,955 gross valued at $8,328. Of this total, Peru took 7,759 gross valued at $1,485; Chile 5,223 gross valued at $534; Cuba 4,805 gross valued at $689; Canada 3,800 gross valued at $381; Argentina 3,424 gross valued at $1,102; New Zealand 3,156 gross valued at $580; Philippine Islands 2,888 gross valued at $523; Brazil 2,646 gross valued at $407; Nicaragua 2,540 gross valued at $393; Mexico 1,961 gross valued at $280; Venezuela 1,667 gross valued at $270; Ecuador 1,050 gross valued at $234; other Asia 1,006 gross valued at $295.

✦ ✦ ✦

EXPORTS of brass wood screws during the same month totaled 6,538 gross valued at $3,740. Of this total the Philippine Islands took 2,188 gross valued at $1,873; Peru 1,605 gross valued at $675; Cuba 856 gross valued at $246; Chile 555 gross valued at $107; Canada 531 gross valued at $407; Colombia 255 gross valued at $149.

✦ ✦ ✦

IMPORTS of wood screws during the same month totaled 44,219 gross valued at $3,590. Of this total Belgium supplied 33,619 gross valued at $2,633 and Japan 10,600 gross valued at $957.

✦ ✦ ✦

AS the German Association of wood screw makers reports, business in 1938 has been about the same as in 1937 with a small increase of total turnovers. The industry has unfilled orders in hand for 4-5 months. Export demand is improving, but prices are rather weak. Bolts and nuts were in small demand on the export market up to November, but since then business has improved. Rivets were very urgently demanded all through 1938 (22% more sold in 1938 than in 1937) and the demand is still maintained.

Stresses in Helical Compression Springs

(*Continued from Page 170*)

STATED in this form, the problem is no longer one for the mathematicians; it becomes definitely the problem of the research engineer. The function of this paper is to describe the problem, rather than to suggest solutions. However, the author has for some time been convinced that we must look primarily to the experimental laboratory for our code of design for helical springs.

✦ ✦ ✦

Bibliography

BIBLIOGRAPHY

1 "Stress of Cylindrical Helical Springs With Circular Cross Section," by A. Röver, Zeit. V. D. I., vol. 57, 1913, pp. 1906-1911.

2 "Constructor," by F. Reuleaux, a handbook of machine design from the fourth enlarged German edition by H. H. Suplee, 1894.

3 "Stress in Heavy Closely Coiled Helical Springs," by A. M. Wahl, Trans. A.S.M.E., vol. 51, part 1, 1929, paper APM-51-17, pp. 185-200.

4 "Shear Stresses in Helical Springs," by L. E. Adams, The Engineer, vol. 151, June 26, 1931, pp. 698-699.

5 "The Calculation of Cylindrical Helical Springs," by O. Göhner, Zeit. V.D.I., vol. 76, 1932, pp. 269-272.

6 "Stress and Deflection of Helical Springs," by R. F. Vogt, Trans. A.S.M.E., vol. 58, August, 1936, paper RP-58-14, pp. 467-475.

7 "Analysis of Stress in a Helical Spring of Circular Wire," by H. C. Perkins, presented at the Annual Meeting of The American Society of Mechanical Engineers, December, 1933, unpublished.

8 "Deflection and Stress in Helical Compression Springs," by H. C. Keysor, presented at the Annual Meeting of The American Society of Mechanical Engineers, December, 1934, unpublished.

✦ ✦ ✦

NOTE: Statements and opinions advanced in papers are to be understood as individual expressions of their authors, and not those of the Society.

Manufacturers of materials, tools and equipment for wire drawing and forming plants are constantly making improvements and additions to their lines. If you do not find the product or service in which you are interested, additional information will be supplied promptly. Simply address:

WIRE & WIRE PRODUCTS

17 East 42nd St. New York City

HAVE YOU A PATENT, A PROCESS OR AN INVENTION APPLICABLE TO THE WIRE INDUSTRY YOU DESIRE TO SELL OUTRIGHT OR TO PLACE ON A ROYALTY BASIS?

✦ ✦ ✦

A Well Known Wire Mill Consulting Engineer Is Prepared To Present Such Matters To His Extensive Acquaintance In The Wire Industry.

✦ ✦ ✦

Correspondence Desired With Principals Only.

✦ ✦ ✦

Representation On Either A Fee Basis Or Percentage Of Royalty Secured.

✦ ✦ ✦

All Communications Held In Confidence.

✦ ✦ ✦

Box 112

WIRE & WIRE PRODUCTS

17 E. 42nd. St.

NEW YORK, N. Y.

THE WATSON MACHINE COMPANY

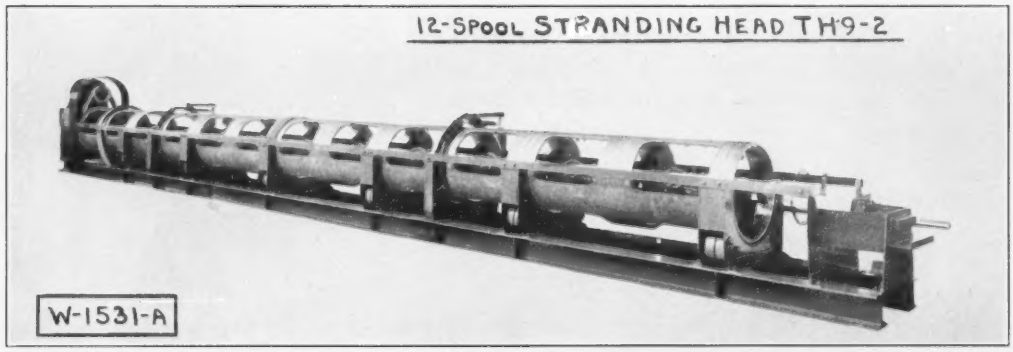
ESTABLISHED 1845

PATERSON, NEW JERSEY, U. S. A.

TUBULAR STRANDING MACHINES

Standard Sizes For From 5 to 1000 Pound Spools

Silent Support Rolls—All Steel Rotor—Vee Belt Drive—Electric Stops



ELECTRICAL WIRE, CABLE & WIRE ROPE MACHINERY

Printed Literature Available On Considerable Of The Equipment Used In These Fields—Inquiries Are Invited

A Review of Recent Wire Patents

No. 2,142,185, SCREW, Patented January 3, 1939 by Joseph F. Fieg, La Grange, Ill., assignor to United Screw and Bolt Corporation, Chicago, Ill., a corporation of Ohio.

This screw has a tool receiving socket, with a portion of the circumferential walls of the socket being eccentric with respect to the longitudinal axis of the socket.

✦ ✦ ✦

No. 2,142,259, SPRING CONSTRUCTION, Patented January 3, 1939 by George Stinson, Gardner, and Severine Hendrickson, Templeton, Mass., assignors to Heywood-Wakefield Company, Boston, Mass., a corporation of Mass.

Binding wires for coil spring assemblies are provided, comprising one straight wire and one short wire wrapped helically thereabout, with a clip embracing a portion of each wire and the adjacent coil spring.

✦ ✦ ✦

No. 2,142,394, WIRE DRAWING, Patented January 3, 1939 by Edward H. Harris, Bridgeport, Conn., assignor to Wheeler Insulated Wire Company, Bridgeport, Conn., a corporation of Conn.

The inventor interposes a wire-reducing and polishing die between the traversing pulley of the spooling means and the spool or bobbin upon which the wire is wound.

Complete Descriptions and Drawings of Patents May Be Had for 25 cents. Address, Wire & Wire Products, 17 East 42nd St., New York.

No. 2,142,399, SPRING CUSHION AND MATTRESS STRUCTURE, Patented January 3, 1939 by Abraham Krakauer, Brooklyn, N. Y., assignor to Kay Manufacturing Corporation, Brooklyn, N. Y., a corporation of New York.

An arrangement of light wire coil springs is provided, with a reduction in the spaces between springs to be bridged by the padding material of the mattress or cushion.

✦ ✦ ✦

No. 2,142,508, MACHINE FOR MAKING WIRE STRAPS, Patented January 3, 1939 by Edwin S. Hall, New Haven, Conn., assignor to Griplock, Inc., New York, N. Y., a corporation of Delaware.

Means is provided for forming a locking seal on one end of a continuous supply of wire and cutting the wire to form a strap of any predetermined length.

✦ ✦ ✦

No. 2,142,509, MACHINE FOR MAKING WIRE STRAPS, Patented January 3, 1939 by Edwin S. Hall, New Haven, Conn., assignor to Griplock, Inc., New York, N. Y., a corporation of Delaware.

This patent is related to the last and includes a locking seal former which controls the position and movement of the free end of the wire supply as it is being twisted around the shank or body of the wire.

✦ ✦ ✦

No. 2,142,625, HIGH TENSION CABLE, Patented January 3, 1939 by Daniel Allard Coert Zoethout, Driehuis-Westerveld, Netherlands, assignors to N. V. Hollandsche Draad-en Kabelfabriek, Amsterdam, Netherlands.

The invention lies in the insulation covering, at least one layer of this insulation being conductive by having lithopone and a finely divided conductive material, having a specific resistance of less than 1 megohm per cubic centimeter.

✦ ✦ ✦

No. 2,142,865, METHOD OF MANUFACTURING FILAMENTS, Patented January 3, 1939 by William P. Zabel, Cleveland Heights, Ohio, assignor to General Electric Company, a corporation of New York.

One of the objects of the invention is to provide double and triple helical wire filaments of equal length and free of deformity.

✦ ✦ ✦

No. 2,143,552, MANUFACTURE OF PAPER-MAKERS' WIRE CLOTH, Patented January 10, 1939 by Willie Dunstan Theodore Green, Edinburgh, Scotland, assignor to The United Wire Works,

Mica applied to wire or cable

Cleanly · Uniformly · Economically

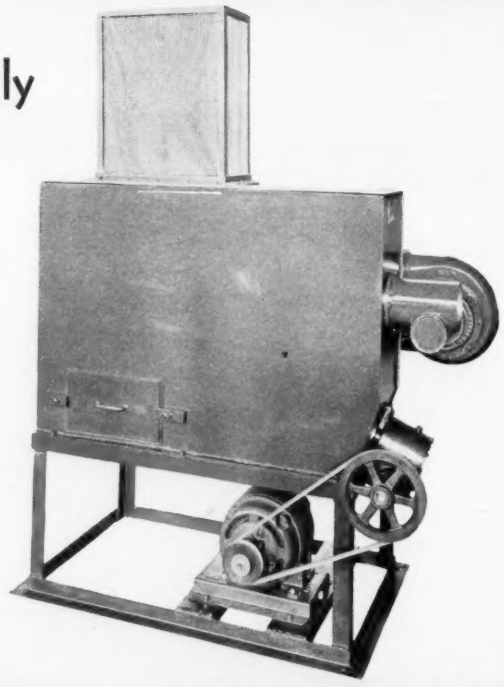
by Syncro Mica Appliers

The Syncro Re-Circulating Mica Applier coats wire or cable with powdered mica or similar materials. To assure complete and uniform coverage, the mica surrounding the wire or cable is under compression and a motor driven feeding mechanism maintains a constant supply at the point of application.

All surplus and loose mica is retrieved before the wire or cable leaves the unit by a highly efficient vacuum system.

Cleanliness, economy, uniformity and efficiency are assured by Syncro Re-Circulating Mica Appliers.

For complete information, write for bulletin No. 500.



SYNCRO

SYNCRO . MACHINE . COMPANY

420 Lexington Avenue New York

Limited, Granton, Edinburgh, Scotland.

A twill weave or long crimp papermakers' wire cloth is provided, without departing from the use of warp wires of circular cross-section, yet obtaining ample drainage characteristics.

✦ ✦ ✦

No. 2,143,742, SPRING ASSEMBLY, Patented January 10, 1939 by Frank S. Price, Holland, Mich., assignor to Charles Karr Company, a corporation of Michigan.

The ends of the transverse rows of spirals of twin springs are of spiral construction so that clinking within the helicals may be avoided.

✦ ✦ ✦

No. 2,143,969, METHOD AND APPARATUS FOR WELDING STRIP END TO END, Patented January 17, 1939 by Florence C. Biggert, Jr., Crafton, Pa., assignor to United Engineering & Foundry Company, Pittsburgh, Pa., a corporation of Pennsylvania.

This apparatus is for butt-welding metal strips together and for trimming the ends before welding, as well as for trimming flash from the line of weld.

✦ ✦ ✦

No. 2,144,387, SPRING MAKING MACHINE, Patented January 17, 1939 by George G. Powers and Clarence H. Frederick, Chicago, Ill., assignors, by direct and mesne assignments, to The Powers Spring Corporation, Chicago, Ill., a corporation of Illinois.

The machine is said to be adapted to produce wire springs of type disclosed in U. S. patent 1,963,052 of June 12, 1934, and is an improvement upon the machine described in U. S. patent 1,968,802 of July 31, 1934.

✦ ✦ ✦

No. 2,144,540, WIRE CUTTING APPARATUS, Patented January 17, 1939 by Ferdinand Lindgren, Bridgeport, Conn., assignor to Boering Specialty Co., Bridgeport, Conn., a corporation of Connecticut.

A small, portable apparatus is provided for cutting insulated wires employed in house wiring and the like.

✦ ✦ ✦

No. 2,145,081, END COIL REDUCING MACHINE, Patented January 24, 1939 by Joseph Gogan, Lakewood, Ohio.

Squared ends of the wire coils are formed by this machine without subsequent grinding operations.

✦ ✦ ✦

No. 2,145,092, HIGH TENSION ELECTRIC CABLE, Patented January 24, 1939 by Earle A. Mitchell, Hastings on Hudson, N. Y., assignor to Phelps Dodge Copper Products Corporation, New York, N. Y., a corporation of Delaware.

The invention is concerned with a covering for the wire cable, which covering will preserve the oil or grease from escaping during periods of thermal expansion.

✦ ✦ ✦

No. 2,145,182, HIGH PRESSURE FLUID INSULATED ELECTRIC CABLE, Patented January 24, 1939 by Ernst Kirch, Berlin-Friedenau, Germany, assignor to General Electric Company, a corporation of New York.

It is said that this cable may be wound on and unwound from reels of conventional construction.

German Notes

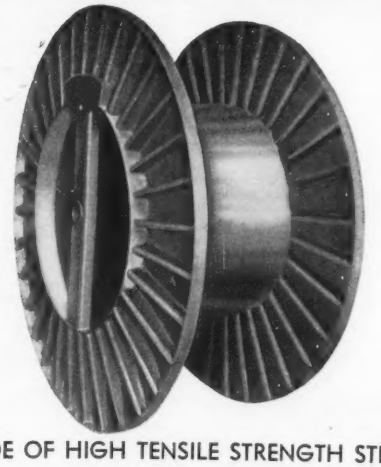
ON the export market no important changes are present. During the Christmas holidays business was dull up to the second week of January, but since has improved satisfactorily. January turnovers will be considerably above those of January, 1938. The demand is great from the Near East and the Balkans, whereas the Far East as well as Latin America is quiet and South Africa shows a revival of business. No change in prices of any importance. Price cutting is rare and only for small quantities.

✦ ✦ ✦

STANDARDIZATION in the wire industry has been postponed due to more urgent work. It will be resumed this year, to facilitate production with less labour. The wire industry has already set up a standardization committee which will issue new standards, probably in the spring.

FOR ECONOMY
INVESTIGATE

STEVENS *LOW-TARE* STEEL SHIPPING REELS



MADE OF HIGH TENSILE STRENGTH STEELS

LOW WEIGHT

PLUS

LONG LIFE

WHAT STEVENS *LOW-TARE* REEL ECONOMY MEANS FOR ONE USER

	STANDARD REEL WOODEN HEADS AND STEEL DRUM	STEVENS *LOW-TARE* STEEL REEL	SAVING IN WEIGHT ON EVERY SHIPMENT
SIZE A	358#	225#	133#
SIZE B	470#	300#	170#
SIZE C	692#	520#	172#

MADE IN STANDARD I.P.C.E.A.
AND SPECIAL SIZES UP TO 84" DIAMETER.
WILL FURNISH COMPLETE DATA AND
PRICES UPON REQUEST.

THE STEVENS METAL PRODUCTS COMPANY
NILES, OHIO

Nema Announcements

THE National Electrical Manufacturers Association announces the release of a new Standard entitled "NEMA Distribution Cutout Standards, Publication No. 38-53."

✦ ✦ ✦

THIS pamphlet contains standards relating to rating of distribution cutouts, performance, application, and manufacturing. All of the latest standards on this type of product that have been approved by this Association have been included. On the back cover is a list of the member companies of the Distribution Cutout Group of NEMA.

✦ ✦ ✦

THE National Electrical Manufacturers Association also announces the release of a new Standard entitled "NEMA Specialty Transformer Standards, Publication No. 38-52." This book is divided into five parts as follows:

✦ ✦ ✦

PART I—Doorbell Transformer Standards. These Standards define a line of transformers designed primarily for doorbell ringing service. Such transformers have limited power output and are capable of withstanding the short circuiting of secondary terminals without burnout or excessive heating.

✦ ✦ ✦

PART II—Signalling Transformer Standards. These Standards define a line of small air cooled power transformers designed primarily for supplying power at low voltages to signalling systems which generally require greater power than the doorbell type transformers are capable of delivering.

✦ ✦ ✦

PART III—High Reactance Control Transformer Standards. These Standards define a line of specialty transformers of limited power input, capable of withstanding the short circuiting of secondary terminals without burnout or excessive heating, and capable of delivering somewhat greater power output than doorbell transformers. Common applications are the operation of large bells, groups of bells, chimes, furnace damper control, and valves and relays of heating and air-conditioning equipment.

✦ ✦ ✦

PART IV—General-Purpose Specialty Transformer Standards. These Standards cover a class of specialty transformers generally known as general purpose transformers. Essentially they are dry type distribution transformers, and are generally used with primaries connected to secondary circuits, to supply lighting and small power loads at still lower voltages.

✦ ✦ ✦

PART V—Luminous Tube Transformer Standards. These Standards define a line of transformers to meet the general requirements of the sign manufacturer; and limit application to luminous tubing having conventional types of internal electrodes only.

REMOVAL NOTICE

On and After April 15th, 1939

THE EXECUTIVE OFFICES OF

1. Wire & Wire Products
2. The Wire Association
3. The Quinn-Brown Publishing Corp.

WILL BE LOCATED AT

Stamford Trust Company Building

300 Main Street, Stamford, Connecticut

ROOMS 609-611-613

THE TELEPHONE NUMBER AFTER APRIL 15th WILL BE STAMFORD 3-0482

COPIES of the complete Standard in loose-leaf form or of any of its parts may be obtained from the National Electrical Manufacturers Association, 155 East 44th Street, New York, N. Y. at the following prices: Complete Standard $1.10, Part I $.15, Part II $.25, Part III $.15, Part IV $.75, Part V $.25.

✦ ✦ ✦

Central States Industrial Engineers

THE Central States Industrial Engineers, with headquarters at DeKalb, Illinois, U. S. A., was recently organized by Messrs. H. A. Nelson, L. F. Pries and E. K. Hansen.

✦ ✦ ✦

THE purpose for the organization is the surveying of the industrial requirements of plants, together with the designing of new machinery, equipment and products, and engineering services for appraisal purposes of all kinds.

MR. NELSON, who is the President of the company, has a varied experience of over 30 years in technical and engineering work, combined with a broad knowledge of management, production, maintenance, repairs, construction and designing of new machinery. Mr. Pries, the Vice President, is a graduate in electrical engineering from Rensselaer Polytechnic Institute and further, holds a degree of Master of Electrical Engineering. Mr. Hansen, the Secretary and Treasurer, has spent 25 years in mechanical engineering work and appraisal engineering work for large steel corporations.

✦ ✦ ✦

Low Accident Record

THE Pittsburgh Plant of Columbia Steel Company completed the year of 1938 with only nine industrial accidents. Of the nine accidents none was of a fatal nature.

THE accident survey covers a period of ten years of operations at the Columbia Plant and shows a rapid decrease in industrial accidents since the year of 1928 when five hundred and forty accidents were recorded.

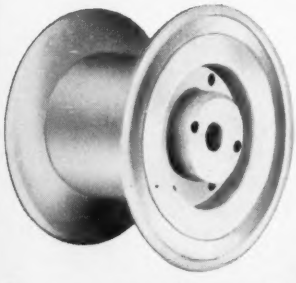
✦ ✦ ✦

OF particular note in the survey is the fact that the Tin Plate Mill, which is the largest department of the Plant, has completed two years of operations without a single lost time accident. This amounts to two million man hours without injury to an employee. The Maintenance department of the mill reported working five hundred thousand man hours since 1934 without an accident.

✦ ✦ ✦

M. P. LEWIS, former Eastern District Manager, Wire Sales, United States Rubber Co., recently appointed assistant manager, Wire Sales Department, with headquarters at the company's main office, 1790 Broadway, New York City.

FINE WIRE HIGH SPEED WIRE DRAWING SPOOLS



James Day (Machinery) Ltd.,
Sentinel House,
Southampton Row,
London, W. C. I, England.

MOSSBERG **PRESSED STEEL** CORP.

Announces a complete line of HEAVY DUTY PRECISION SPOOLS and REELS especially designed for high speed wire drawing and annealing.

The degree of efficiency obtained by the HIGH SPEED WIRE DRAWING MACHINE is largely dependent upon the accuracy and durability of the take-up spool.

The use of our PRECISION SPOOLS will increase your machine efficiency and eliminate your spool difficulties.

Complete range of sizes.

MOSSBERG PRESSED STEEL CORP

18 West Street,
ATTLEBORO, MASSACHUSETTS, U. S. A.

COMBINATION
500 lb. CAPACITY WIRE DRAWING — ANNEALING — STRANDING — REEL.

Why the Treasurer likes Duriron Equipment:

Because Duriron means lower repair bills!

Treasurers are queer guys—they can spot a leak miles away. And do they love equipment that keeps working on and on, with few repair bills!

Here's what one Treasurer told us:

"About 12 years ago we bought two No. 102 Duriron pumps—one as a stand-by. These were for handling acid in all strengths at temperatures from 80°C to 120°C. In all this time the only trouble we have had was last month (November) when a chunk of aluminum got into the pumps. The chunk was taken out, the pump reassembled and started to pumping again. Roughly estimated, this pump has handled 15,000,000 gallons of solution without one cent being spent for repairs. The spare pump, by the way, is still standing-by in the original crate."

He's one Treasurer who's happy about the whole thing. If you want to make your Treasurer happy, put Duriron equipment on your acid handling jobs.

Write for Bulletins on Duriron Equipment

THE DURIRON COMPANY, Inc.

445 North Findlay St. Dayton, Ohio

You Can Reduce Die Cutting Costs . . .

With NORBIDE Abrasive

NORBIDE ABRASIVE—an important development by the Norton Research Laboratories — is the hardest material ever produced by man for commercial use. In the re-cutting of wire drawing dies it is showing remarkable savings. Because its cost is but a small fraction of that of diamond dust; it can be used more generously. The result is a cutting action that is just as fast but at a greatly reduced cost.

NORTON COMPANY
WORCESTER, MASS.

NORBIDE is the registered trade mark for Norton Boron Carbide (B_4C)

N-22

NORTON ABRASIVES

Republic's New Gadsden Plant

(*Continued from Page 163*)

THE four stands in the cold mill were moved to the east end of the box-annealing building and provided with an independent motor drive. A second pickling unit and a latest type galvanizing machine were installed, as well as a new scrubber and dryer. With the new equipment a complete line of highest quality galvanized products including corrugated, V-crimped, and rolled roofing and roofing trim materials is now available.

✦ ✦ ✦

THE new bolt and nut plant is equipped to produce a complete line of building, carriage and machine bolts from 3/16th to 1½ inches. Total bolt making capacity is 1,000 tons per month.

✦ ✦ ✦

THE new bolt building, the first wing of which houses the forge shop, is designed to eventually cover 200,000 square feet. It is conveniently located next to the bar mill. Present bolt-making equipment includes 8 cold-headers for making 3/16th to ½ inch stock up to 6 inches long, and 8 hot-headers for making from ⅜th to 1½ inch bolts and rivets. In addition there is all the necessary hot and cold trimmers and cutters, two-hot-press nut machines and the necessary burring machines, a heat treating furnace, and complete threading and tapping equipment.

✦ ✦ ✦

THE sheet mill warehouse was extended 144 ft. and six other mill buildings were enlarged. The improvement program entailed considerable other incidental rearrangement, and important additions to power lines, conveying and heating facilities, track layout, and so on.

✦ ✦ ✦

THE new office building is a two-story fireproof structure, 42 by 122 feet.

CAROLINA CREST HOTEL

A Beachfront Hotel Just Off Beachfront

On Beautiful

North Carolina Ave., Atlantic City

Serving a

TRAY BREAKFAST

to your room any time up to 11 o'clock without any charge for breakfast or service.

EVERY ROOM HAS PRIVATE BATH

and at least three large windows

SINGLE AS LOW AS $2.50

DOUBLE AS LOW AS $5.00

HARRY L. FAIRBAIRN, Prop.
H. L. FAIRBAIRN, Jr., Mgr.

BALLOFFET

Diamond Dies

Skill and accuracy in manufacture with the use of selected stones make Balloffet Diamond Dies the choice of the most critical users.

•

Quality Diamond Dies Since 1870

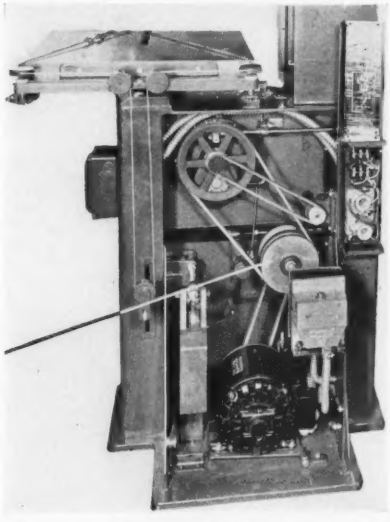
BALLOFFET DIES AND NOZZLE CO., INC.
45-47 Adams Street
Guttenberg, New Jersey

New "Speedmaster" Drive

CONTINENTAL Machine Specialties of Minneapolis, announce an improved design and lower price for their Speedmaster Variable Speed Pulleys. These new infinitely variable speed pulleys are moulded of solid high impact strength bakelite, accurately trued and balanced before final assembly. An improved pressure lubricated bronze sleeve allows the splined center sheave member to operate freely, regardless of load or speed.

✦ ✦ ✦

THE new construction is available in two sizes, a 3½" diameter size for drives up to ½ HP capacity and a 6½" diameter size for drives up to 3 HP capacity. The pulley is very flexible in its adaptability to both "straight line" and "angular" drives. Interposed



between motor and driven unit, the position of the pulley can be changed to vary the center distances of the Speedmaster pulley in relation to the drive and driven sheaves. The belts thus assume smaller or larger operating pitch diameters through the action of the variable pulley faces. Control of speed is made through a quick action lever, or a handwheel allowing control of speed within 1 RPM. The entire unit is free floating so that belt alignment is accurately maintained at all times.

✦ ✦ ✦

ADVANTAGES claimed by the manufacturer for the improved Speedmaster are; a six-to-one up to a forty-to-one ratio of infinitely variable speed, the use of standard "V" belts, and long belt and pulley life because of the moulded plastic work faces.

✦ ✦ ✦

THIS wide range transmission was originally developed for use in the company's "DOALL" Contour Band Sawing Machine and was later produced as a separate unit for general applications, such as spring coilers, wire forming machines, etc.

There is MORE quality in the diamonds used for making Rusch Wire Dies,

MORE accuracy in making Dies the Rusch scientific way,

MORE uniform wire produced throughout the life of Rusch Wire Drawing Diamond Dies!

YET prices are low and service always dependable.

For further particulars address

RUSCH WIRE DIE CORP.
275 Seventh Ave., New York, N. Y.

KEEP POSTED!
Subscribe Now To
WIRE & WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip. Wire Products and Insulated Wire and Cable.

and

You Will Receive Every Month Data on the Latest Technical Developments in Your Industry.

$5.00 Per Year
Canada $5.00
Foreign $7.50 Per Year

REMEMBER

That 95% of the world's pickling is done with

RODINE

to save metal and money, to make a better product.

If you have a metal-finishing problem--pickling, cleaning, rust - proofing, painting--consult our experts gratis.

AMERICAN CHEMICAL PAINT CO.
AMBLER PENNA. Detroit 6339 Palmer Ave., E.

The Development of Keystone Wire Fence

FIFTY years ago while every farmer hated fence building, no one had ever done anything about it, except Peter Sommer—a substantial and respected Illinois pioneer farmer. He realized how many weeks of labor out of every year were spent, without return, in simply keeping up fences. So he started looking for a better fence than rails. He found it in woven wire.

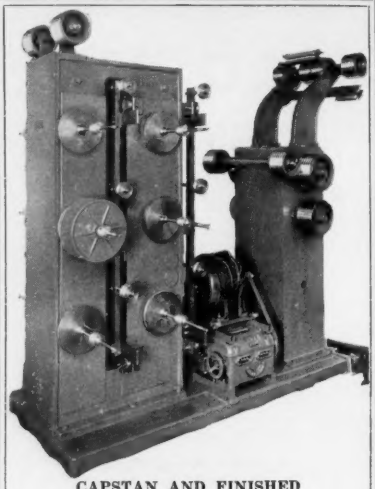
✦ ✦ ✦

FIRST experimenting with cross wires twisted by hand into line wires stretched on posts in the field, Peter Sommer finally hit on a practical weave, forming openings shaped like a Keystone. From that the fence got its name. But it was too slow making fence by hand, so his next task was to devise a machine to weave the fabric. Then, he realized it would have commercial possibilities and every farmer could have wire fence to replace those clumsy, wasteful rails.

✦ ✦ ✦

Sommer's First Fence Weaving Machine Was Invented in 1889

FINALLY, after a great deal of patient, inspired labor, Peter Sommer completed his first fence weaving machine. That was in 1889—just fifty years ago. It was crude and slow, operated entirely by hand, and required the labor of two men and a boy. It would turn out only ten rods of the new Keystone fence in a 12 hour day. But the fence was so practical, so much better than anything farmers had ever dreamed of, that it was immediately in great demand. The little shed housing Peter Sommer's fence weaving machine became the first factory of the Keystone Steel and Wire Company. From it has grown, in the past half a century, the world's largest independent steel and wire mills.



CAPSTAN AND FINISHED WIRE REEL STAND for one side of MODEL H-20 ENAMELING MACHINE.
Ball Bearing, Speed Variator, Motor Drive.
New England Sales Representative: Sidney B. Blaisdell 228-232 Aborn St., Providence, R. I.

EST. 1855 AIMCO INC. 1915
"American" INSULATING MACHINERY COMPANY
REG. U.S. PAT. OFF.
517 West Huntingdon St.
PHILADELPHIA PENNSYLVANIA U.S.A.

TUNGSTEN CARBIDE
DIES BY WILLEY'S

A special Grade of Tungsten Carbide, (covered by U. S. Patents) with the proper characteristics for Dies—free from porosity—offers great resistance to abrasion and takes a polish equal to diamonds. These and other important characteristics make this metal ideal for sizing, extrusion and wire drawing Dies.

Write for bulletin showing specifications and latest prices.

WILLEY'S CARBIDE TOOL CO.
MANUFACTURERS AND SPECIALISTS IN
TUNGSTEN CARBIDE TOOLS
1340 W. VERNOR HIGHWAY • DETROIT, MICHIGAN

Dies for
High Speeds
Long bearing Dies
Short bearing Dies
Special bearing Dies

FAMOUS
WIRE DRAWING DIAMOND DIES

VIANNEY

250 E. 43rd St. • New York

Largest Stocks in U.S.A.
Quickest Deliveries
Safest Guarantees
Best Selections
Lowest Costs

Many Improvements Have Come In Fifty Years of Fence Making

THE first Keystone fence was good. Some of the wire woven on that old hand operated machine stood in the field for more than 20 years. But it was characteristic of Peter Sommer and the firm he founded that it was never good enough. Years of practical farm use and constant experimenting brought, not only better and more efficient machines for producing uniform, well-woven fabric, but also many improvements in the fence itself.

✦ ✦ ✦

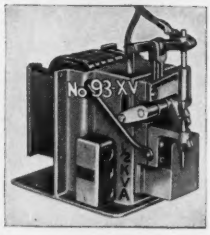
IT was found, through research and through tests, that the addition of from 20 to 30 points of copper to the steel made it resist rusting two to three times as long as steel without copper. A revolutionary improvement in the method of zinc coating fence wire was developed and patented by Keystone. The process is called "Galvannealing" and resulted in greatly increasing the useful life of Keystone fence in service. Other improvements were made in the fabric itself — more compact, tightly formed knots, crimps in the line wires to allow for natural expansion and contraction in the line wires, many different heights, weights and types of fabrics to suit various purposes.

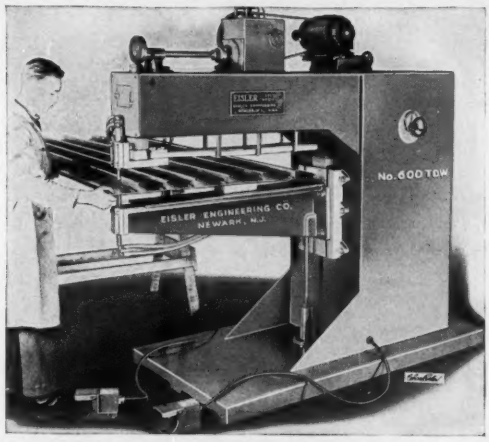
✦ ✦ ✦

Unusual Advertising Campaign Marks Keystone's 50th Anniversary

THIS Spring Keystone marks fifty years of fence making with an interesting departure in fence advertising. Farm paper ads, posters, direct mail, catalogs, motion pictures and even radio will carry the story of how woven wire fence was invented. They will point out dramatically the hard, back-breaking labor that went into the old rail fences, and how it led to the development of the efficient, economical woven wire fencing universally used today.

Bench Spot Welder
Foot Operated





We manufacture Electric Welders from ¼ to 500 KVA. Special and Standard Types. WE MAKE A VERY LARGE VARIETY of Welders. Why not ask for more information or a catalog?

EISLER ENGINEERING CO.
760 S. 13th St. (Near Avon Ave.)
Newark, New Jersey

WIRE NAIL MACHINERY

These machines are made in eleven different sizes. This enables us to cover any size of nail most efficiently.

GLADER Nail making machines have been adopted as standard equipment in all recent major nail mill installations.

For further information, prices, etc., write to us.

Wm. Glader Machine Works

210 N. RACINE AVENUE, CHICAGO, ILL.

STEELSKIN

REG. U. S. PAT OFFICE

For High or Low Carbon Wire

WIRE DRAWING SOAPS

Established 30 years

R. H. MILLER CO., Inc. **Homer, N. Y.**

STEEL WIRE

By MAURICE BONZEL

Translated and Published by Kenneth B. Lewis, Consulting Engineer

Price $15.00

495 pages. 414 charts, photomicrographs and illustrations

SEND ORDERS TO

WIRE and WIRE PRODUCTS

17 E. 42nd STREET, NEW YORK

Learn about PARALAN

Paralan will give your finished wire and wire products protection from atmospheric corrosion in the mill and in shipping. Paralan-coated wire can be spot welded or soldered without cleaning. Also, Paralan leaves surfaces in good condition for all types of finishes—enameling, japanning, lacquering, plating, etc.

Write for further information. We may be able to solve your difficulties.

AMERICAN LANOLIN CORP.
LAWRENCE, MASSACHUSETTS

HAVEG TANKS

THAT DO NOT LEAK — ARE UNAFFECTED BY PICKLING ACIDS, OR BY RAPID TEMPERATURE CHANGES. CAN BE USED UP TO 265° F.

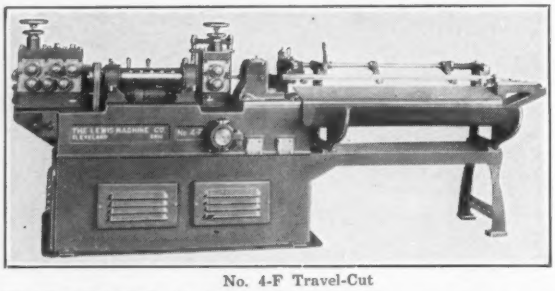
SEND FOR BULLETIN WB1

A MOLDED PHENOLIC RESIN ASBESTOS COMPOSITION

HAVEG CORP., NEWARK, DEL.

LEWIS Wire Straightening and Cutting Machines

— Automatic—High Speed—Heavy Duty —



No. 4-F Travel-Cut

Machines to Handle 3/32" to 3/4" Rod

Round - Square - Flat - Hex Ferrous and Non-Ferrous

Write For Bulletin

The Sign of Dependable Service:

WE CAN SUPPLY AND ENGINEER OUR TOOLS EQUIPPED WITH CARBOLOY CEMENTED CARBIDE

THE LEWIS MACHINE CO., 3440 E. 76 ST., CLEVE., O.

PATENTS — TRADEMARKS

All cases submitted given personal attention.
From "Evidence of Conception"
with instructions for use and
"Schedule of Government and
Attorneys' Fees"—Free

Lancaster, Allwine & Rommel

Patent Law Offices

438 Bowen Bldg. Washington, D. C.

Volume on Creep Data

COMPILED by the Joint A.S.M.E.—A.S.T.M. Research Committee on the Effect of Temperature on the Properties of Metals and published by the two societies, this volume of 864 pages affords in convenient form important data on high-temperature creep characteristics of metals and alloys. The 486 sheets of test data, 273 graphs and 37 tables cover wrought steels and ferrous alloys, cast steels and ferrous alloys and non-ferrous materials.

✦ ✦ ✦

EXTENSIVE tables give complete data on the large number of materials considered. There are charts of stress and corresponding creep rate for each type of material at each temperature; curves of temperature versus creep rate (0.10 per cent per 1000 hours) for each type of material wherever sufficient data were available; tabulated forms which give detailed descriptions of each material including its form, heat treatment, chemistry, hardness, grain size after the McQuaid-Ehn test, impact values, initial physical properties, manufacturing data, room temperature properties of specimens after creep tests, creep characteristics, and in so far as possible photomicrographs showing the initial microstructure and microstructures of completed creep specimens.

✦ ✦ ✦

COPIES of this extensive publication can be obtained from either Society, A.S.T.M., 260 S. Broad St., Philadelphia, Pa., or A.S.M.E., 29 West 39th St., New York City, at $12 each postpaid in the U. S. and Canada; elsewhere $14, postpaid.

This is an invitation for you to become a member of The Wire Association. ✦ ✦ ✦ ✦ ✦ ✦

The Annual Dues are $10.00

For Details Address

Richard E. Brown, Secretary
The Wire Association
17 E. 42nd St., New York, N. Y.

SCHUMAG
CONTINUOUS BAR MAKING
STRAIGHTENING AND POLISHING MACHINES
W. A. SCHUYLER
FISK BLDG. NEW YORK

BRODEN
Wire Mill and Cold Rolling Equipment
Broden Construction Co.
11730 Harvard Ave.
CLEVELAND, OHIO

WIRE DRAWING MACHINERY AND EQUIPMENT
Rod Frames — 16″ Frames, 8″ Frames — Take-Up Frames, Wire Pointers—Puller Tongs.
General Castings for Wire Mill use.
Circulars on Request.
E. J. SCUDDER FOUNDRY & MACHINE CO.
TRENTON, N. J.

RUESCH
Machinery For
Wire, Tube, And Brass Mills
409 Mulberry St., Newark, N. J.

WIRE, WIRE ROPE AND ELECTRIC CABLE MACHINERY
THOMSON-JUDD
WIRE MACHINERY COMPANY
SUBSIDIARY OF THOMSON-GIBB ELECTRIC WELDING COMPANY
LYNN, MASSACHUSETTS
WRITE FOR CATALOGUE

DIAMOND CARBIDE
DIES
KELLY
WIRE DIE CORPORATION
19 W. 34th St. New York

Continuous Straightening and Cutting Machinery
With
FLYING SHEAR
for round and shaped wire.
✦ ✦ ✦
THE HALLDEN MACHINE COMPANY
THOMASTON CONNECTICUT

"You and Your Money"

C. DONALD DALLAS, President of Revere Copper and Brass Company writes a new book on the practical treatment of the economic and human problems of today! In it he states: "The only formula for providing work and prosperity is to produce with the aid of science the largest possible amount of goods, with the least possible amount of human labor, marking each lowering of cost of production by an increase in wages and decrease in selling price, thereby expanding the market for and the use of the product."

✦ ✦ ✦

"TO bring about this state, claims the author, we must have the spirit of enterprise. First someone must have an idea that they can produce an article that the public will use at a price at which the public will use it. Then they must have the courage and ability and resource to make and market it. This requires capital in the form of lands and buildings, machinery, materials and working capital to insure first, payment of weekly wages; second, payment of bills for raw materials; third, taxes and interest on borrowed money. Then, if the venture is successful, and if anything is left over, the stockholders who put up the capital get it, and then they have to pay another tax on what they get."

✦ ✦ ✦

THE book is published by Prentice-Hall, Inc., 70 Fifth Avenue, New York, N. Y., price 1.50 per copy.

Wire Drawing Diamond Dies
COCHAUD
WIRE DIE CORPORATION
300 W. 56th St., NEW YORK
Tel. Col. 5-1340

EYELETS
ZINC WIRE
ZINC STRIP
THE PLATT BROS. & CO.
WATERBURY, CONN.

ZINC WIRE
METAL WORKS, LTD.
SCHEIN BROTHERS
BEDZIN, POLAND

ROYLE
PATERSON N J
BUILDING EXTRUDERS SINCE 1880
Insulating Machinery for Western Electric Continuous Vulcanizing process.
JOHN ROYLE & SONS
PATERSON, N. J.
British Agency: James Day (Machinery) Ltd., Sentinel House, Southampton Row, London, W. C. 1, England

MANUFACTURERS OF
WIRE BRAIDING — SPOOLING — TAPING
WINDING AND SPECIAL MACHINES
SINFRA WIRE COVERING MACHINES
FIDELITY MACHINE CO.
3908-18 Frankford Ave., Phila., Pa.

All Sizes of
Twisted—Folded—Shaped
Paper Insulation Twine
Also Slit Kraft
E. W. TWITCHELL, INCORPORATED
3rd & Somerset Sts., Phila., Pa.

SINFRA
High-Speed Fabric Wire Covering
1 Exchange Place Jersey City, N. J.

HIGH SPEED
Welding Wire Straightening and Cutting Machinery
Round Wire Straightening and Cutting Machinery
Flat Wire Straightening and Cutting Machinery
Roll and Rotary Wire Straighteners
THE F. B. SHUSTER CO.
New Haven, Conn.
Straightener Specialists Since 1866

FOR DRY AND WET DRAWING

Wire Drawing Soaps

Successfully meet recent special demands made by high-speed drawing and the added attention given to brightness and finish.

FOR FERROUS, NON-FERROUS WIRE

MAGNUS CHEMICAL COMPANY 188 South Avenue, Garwood, N. J.

GEORGE D. HARTLEY

CONSULTANT

311 MAIN ST.,
WORCESTER, MASS.

—

• MARKETING OF LATEST PATENTS, INVENTIONS AND PROCESSES •

—

• EXPERT SUPERVISION OF DEVELOPMENT AND EXPERIMENTAL WORK •

Kenneth B. Lewis

CONSULTING ENGINEER

Wire Mill Equipment, Layout and Practice

17 East 42nd St.
New York City
Phone:
Murray Hill
2-4188

43 Midland St.
Worcester, Mass.
Phone:
Worcester
5-6033

WIRE MACHINERY SPECIALISTS

3—Nilson No. 1, 2, 3 & 4 4 Slide Wire Machines
2—Baird No. 3 & S3F 4 Slide Wire Machines
7—Waterbury Step Cone Wire Drawing Machines
4—Block Continuous Wire Drawing Machine, with Stripper, M. D.
8—Shuster Automatic S. & C. Machines 1/32", 1/8", 3/16", 1/4", 5/8", 1/2", also 3/4", 7/8" square wire, motor driven.
Wanted: Wire Spring making machinery.

NATIONAL MACHINERY EXCHANGE
128-138 MOTT ST. NEW YORK, N. Y.

Sidney B. Blaisdell

New England Representative, American Insulating Machinery Co., of Philadelphia, Pa.

THE American Insulating Machinery Co., have appointed Mr. Sidney B. Blaisdell, with offices at 228 Aborn Street, Providence, R. I., as their New England Sales Representative.

✦ ✦ ✦

MR. BLAISDELL, who is a Mechanical Engineer and a graduate of the Massachusetts Institute of Technology, is well qualified to serve the wire manufacturers in New England.

Better Magnet Wire Announced By G. E.

ELIMINATING the need for space-consuming protective coatings in many instances, Formex wire, a new and superior magnet wire announced January 24 by General Electric at the 1939 Winter Convention of the A. I. E. E., New York City, is insulated with a synthetic resin which is tougher and more flexible than the conventional enamel coatings. The new resin is of the polyvinyl acetal type, while ordinary enamel coatings are composed of drying-oil resins. Since Formex wire requires less space for insulation and protection, it gives the designer new opportunities to reduce the size of many products. Further, electrical properties are as good as those of ordinary enameled wires, and tests show that Formex wire is considerably higher in resistance to abrasion and to the common treating solvents. When severely twisted and then subjected to a temperature of 125 C for one hour, ordinary enameled wire cracks but Formex wire is not affected.

✦ ✦ ✦

THE superior qualities of Formex have been demonstrated in the actual manufacture of electrical products. It withstands the operations of winding, assembly, and varnish impregnation much better than commercially available enameled wire. It can be used to advantage in nearly all applications where enameled wire has been used, and in addition it can be utilized in many applications to replace enamel-cotton, enamel-paper, or other fabric-covered wires where formerly a protective wrapping was necessary.

✦ ✦ ✦

THE elimination of these protective coatings has been a major objective of even the earliest workers in the field of magnet wire development—and enameled wire has been a commercial product for more than 30 years. In spite of these efforts the use of enameled wire unprotected has been limited to apparatus for light service, and where winding and assembly permits its application unimpaired.

✦ ✦ ✦

SINCE present manufacturing facilities and the supply of polyvinyl acetal resin are restricted, there has not yet been extensive commercial application of the wire. These limitations are being corrected, however, and it is hoped that adequate supplies of the resin to produce Formex wire will soon be available.

✦ ✦ ✦

New Lubricant for Wet Drawing

A NEW powdered soap for the wet working of copper and brass known as Nopco Soap L, has been announced by the Laboratories of the National Oil Products Co., Harrison, N. J.

✦ ✦ ✦

THE new soap, described as clean, white, and free from odor, has been tested in the company's laboratory and by practical mill men in outside plants. This soap is highly concentrated, resistant to rancidity, economical, and versatile.

✦ ✦ ✦

NOPCO Soap L is recommended for use in the following wet working applications: (1) Drawing or stamping of copper and brass shells (2) Drawing of coarse yellow brass wire (3) Drawing of intermediate yellow brass tubes (4) Drawing of coarse, hard bronze wires.

SITUATION WANTED

Engineer with fifteen years experience in design and construction of Wire Mill and Rope Mill equipment; including Patenting Furnaces; Bakers; Cleaning House Brick Tubs; Take-up Frames; Wire Drawing Benches; Planetary and Tube Type Stranders; Hydraulic Closers and Winders; desires permanent position. Just completed building machinery and buildings for large Rope Mill. Box 307 c/o

WIRE & WIRE PRODUCTS

Index to Advertisers

A

Aetna-Standard Engineering Co. 148
American Chemical Paint Co. 184
American Insulating Machinery Co. 184
American Lanolin Co. 186
Apco-Mossberg Corp. 151

B

Balloffet Dies & Nozzle Co., Inc. 183
Broden Construction Co. 187

C

Carboloy Company, Inc. 141
Carolina Crest Hotel 183
Cochaud Wire Die Corp. 187
Continental Steel Corp. 176

D

Duriron Company, Inc., The 182

E

Eisler Engineering Co., Inc. 185
Electric Furnace Co., The ..... Back Cover

F

Fidelity Machine Co. 187
Firth Sterling Steel Co. 152

G

Glader, Wm., Machine Works 185

H

Hallden Machine Co., The 187
Hartley, Geo. D. 188
Haveg Corp. 186
Hudson Wire Company 145

K

Kelly Wire Die Corp. 187
Keystone Steel & Wire Co. 175

L

Lancaster, Allwine & Rommel 186
Lewis, K. B. 188
Lewis Machine Co., The 186

M

Magnus Chemical Co. 188
Miller, R. H., Co. 185
Morgan Construction Co. ..... Inside Back Cover
Morrison Engineering Co. 146
Mossberg Pressed Steel Corp. 181

N

National Machinery Exchange 188
Norton Company 182

P

Pittsburgh Steel Company 143
Platt Brothers & Co. 187

R

Robertson, John, Co., Inc. 174
Royle, John, & Sons 187
Ruesch Machine Co., H. J. 187
Rusch Wire Die Corp. 183

S

Schein Bros. 187
Schuyler, W. A. 187
Scudder Foundry & Machine Co., E. J. 187
Shuster, F. B., Co., The 187
Sinfra Corp. 187
Sleeper & Hartley, Inc. 164
Stevens Metal Products Co. 179
Syncro Machine Co., Div. of Elevator Supplies Co. 178

T

Thomson-Judd Wire Machinery Co. 187
Torrington Manufacturing Co., The 149
Twitchell, E. W., Inc. 187

V

Vaughn Machinery Co., The ..... Front Cover
Vianney Wire Die Works 184

W

Watson Machine Co., The 177
Willey's Carbide Tool Co. 184
Wilson Engineering Co., Lee 147

Y

Youngstown Sheet & Tube Co., The ..... Inside Front Cover

GOING TO PRESS-MARCH 10, 1939

THE 1939 EDITION OF THE

WIRE & WIRE PRODUCTS'

Buyers Guide and Year Book of the WIRE ASSOCIATION

• BE LISTED • • ADVERTISE •

• ADVERTISING RATES •

4 Pages	$250.00
2 Pages	150.00
1 Page	90.00
Second and Third Covers each	$150.00
One-half Page	60.00
One-quarter Page	35.00
One Inch	7.50
Back Cover	$250.00

WRITE AT ONCE FOR FULL DETAILS

• SPECIAL OFFER •

For $25.00 you can have as many bold face listings under our standard headings as you desire and five one-inch advertisements under or facing the headings you select. Full information will be supplied on request.

WIRE & WIRE PRODUCTS

17 East 42nd Street — OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION — New York, N. Y.

WHERE TO BUY

For more complete information, consult the annual Directory, Index & Buyers' Guide.

ABRASIVES—
Norton Co., Worcester, Mass.

ANNEALING POTS AND BOXES—
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.

ANODES—
Seymour Mfg. Co., Seymour, Conn.

ANTI-RUST—
Magnus Chemical Co., Garwood, N. J.

ARMORING EQUIPMENT—
American Insulating Mach'y. Co., Phila., Pa.
Sleeper & Hartley, Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

BAKERS—Rod and Wire
Morgan Construction Co., Worcester, Mass.
Morrison Engineering Co., Cleveland, O.

BOBBINS—Braider and Wire Weaving
Apco Mossberg Corp., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.

BORON CARBIDE—
Norton Co., Worcester, Mass.

CARRIERS—Braider, High Speed
Apco Mossberg Corp., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.

CEMENT FLOOR CLEANER—
Magnus Chemical Co., Garwood, N. J.

CEMENTS—Refractory
Norton Co., Worcester, Mass.

CHEMICALS—Cleaning
American Chemical Paint Co., Ambler, Pa.
Magnus Chemical Co., Garwood, N. J.

CLEANERS—Hand and Metal
Magnus Chemical Co., Garwood, N. J.

CLEANING & PICKLING EQUIPMENT—
Broden Construction Co., Cleveland, O.
Duriron Co., The, Dayton, O.
Haveg Corp., Newark, Del.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

COATING—Protective
American Lanolin Corp., Lawrence, Mass.

COILERS—Sheet, Strip and Wire
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

CONDUITS—Iron and Steel
Youngstown Sheet & Tube Co., Youngstown, Ohio.

COPHOLDERS—Steel
Apco Mossberg Corp., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.

CRANES—Wire Mill
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

DIAMOND TOOLS—
Rusch Wire Die Corp., New York, N. Y.

DIES—Diamond
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Cochaud Wire Die Co., New York, N. Y.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Lead Extrusion
John Robertson Co., Brooklyn, N. Y.

DIES—Repairs & Re-Cutting
Balloffet Dies & Nozzle Co., Inc., Guttenberg N. J.
Carboloy Co., Inc., Detroit, Mich.
Cochaud Wire Die Co., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.
Willeys Carbide Tool Co., Detroit, Mich.

DIES—Rod and Tube Drawing
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.
Willeys Carbide Tool Co., Detroit, Mich.

DIES—Tantalum Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Tungsten Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DRAW BENCHES—
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O

DRUMS—Flange Steel
Stevens Metal Products Co., Niles, O.

DRUMS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

ENGINEERS—Consulting Wire Mill
Hartley, George D., Worcester, Mass.
Lewis, Kenneth B., New York, N. Y.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FILLERS—Paper for Cable
E. W. Twitchell, Inc., Phila., Pa.

FLASH BAKERS—
Morrison Engineering Co., Cleveland, O.

FURNACES—Annealing
Electric Furnace Co., Salem, O.
Lee Wilson Engineering Co., Cleveland, O.

FURNACES—Automatic
Electric Furnace Co., Salem, O.
Lee Wilson Engineering Co., Cleveland, O.

FURNACES—Bright Annealing
Electric Furnace Co., Salem, O.
Lee Wilson Engineering Co., Cleveland, O.

FURNACES—Electric
Electric Furnace Co., Salem, O.

FURNACES—Galvanizing
Lee Wilson Engineering Co., Cleveland, O.

FURNACES—Hardening and Tempering
Electric Furnace Co., Salem, O.

FURNACES—Lead Melting
Electric Furnace Co., Salem, O.
John Robertson Co., Brooklyn, N. Y.

FURNACES—Non-Oxidizing
Electric Furnace Co., Salem, O.

FURNACES—Normalizing
Electric Furnace Co., Salem, O.

FURNACES—Salt Bath
Electric Furnace Co., Salem, O.

FURNACES—Wire, Strip & Sheet
Electric Furnace Co., Salem, O.

GALVANIZING EQUIPMENT—
Lee Wilson Engineering Co., Cleveland, O.

GRINDERS—ROLL
Norton Co., Worcester, Mass.

INHIBITORS—
American Chemical Paint Co., Ambler, Pa.

INSULATION — Cable or Cable Filler
E. W. Twitchell, Inc., Phila., Pa.

LATHES—Die Reaming
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

LUBRICANTS—For Metal Cutting, Stamping and Drawing
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Homer, N. Y.

LUBRICANTS—Wire Drawing
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Homer, N. Y.

MACHINERY—Armoring (Cable, Wire Hose)
American Insulating Mach'y. Co., Phila., Pa.
John Robertson Co., Brooklyn, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Braiding
Fidelity Machine Co., Philadelphia, Pa.
Watson Machine Co., Paterson, N. J.

MACHINERY—Brazing
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Bunching
American Insulating Mach'y. Co., Phila., Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cable, Electric
American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
Syncro Machine Co., Rahway, N. J.
Thomson-Gibb Electric Welding Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Chain Making
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Closing
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

WHERE TO BUY, Continued

MACHINERY—Coil Winding
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Coilers
Broden Construction Co., Cleveland, O.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Copper Wire Drawing and Rolling
H. J. Ruesch Machine Co., Newark, N. J.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Covering Wire
Fidelity Machine Co., Philadelphia, Pa.
Sinfra Corp., Jersey City, N. J.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Cutting
Broden Construction Co., Cleveland, O.
Hallden Machine Co., Thomaston, Conn.
Lewis Machine Co., The, Cleveland, O.
National Machinery Exchange (Used), New York, N. Y.
F. B. Shuster Co., New Haven, Conn.
W. A. Schuyler, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Enameling
American Insulating Mach'y. Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Extruding
John Robertson Co., Brooklyn, N. Y.
Royle, John & Sons, Paterson, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Flat Wire
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Forming
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Galvanizing
Lee Wilson Engineering Co., Cleveland, O.

MACHINERY—Galvanizing Wire
Broden Construction Co., Cleveland, O.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Gang Winders
Fidelity Machine Co., Philadelphia, Pa.
H. J. Ruesch Machine Co., Newark, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., Worcester, Mass.

MACHINERY—Insulating
American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
Sinfra Corporation, Jersey City, N. J.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Knitting
Fidelity Machine Co., Philadelphia, Pa.
Sinfra Corporation, Jersey City, N. J.

MACHINERY—Lead Encasing Presses, etc.
John Robertson Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
John Robertson Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Magnet Wire
American Insulating Mach'y. Co., Phila., Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY — Measuring Wire & Cable
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works Co., Chicago, Ill.
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Panning
American Insulating Mach'y. Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Pointing
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Rod Mill
Broden Construction Co., Cleveland, O.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
W. A. Schuyler, New York, N. Y.

MACHINERY—Rolling Mill
Broden Construction Co., Cleveland, O.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
H. J. Ruesch Machine Co., Newark, N. J.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Rubber Strip Covering
Watson Machine Co., Paterson, N. J.

MACHINERY—Rubber Tubing and Straining
Royle, John, & Sons., Paterson, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Screw Wire
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y. Co., Phila., Pa.
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY— Special — Combination Machine for Drawing, Cutting-to-length. Straightening and Reeling Bars from Coil in One Operation (Shumag Type)—
W. A. Schuyler, New York, N. Y.

MACHINERY—Spooling
American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spring Making
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Broden Construction Co., Cleveland, O.
Hallden Machine Co., Thomaston, Conn.
Lewis Machine Co., The, Cleveland, O.
National Machinery Exchange (Used), New York, N. Y.
H. J. Ruesch Machine Co., Newark, N. J.
W. A. Schuyler, New York, N. Y.
F. B. Shuster, New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Stranding
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Swaging
National Machinery Exchange (Used), New York, N. Y.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Taping
American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Testing Size of Wire
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y. Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Trolley Wire
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Welding Wire
Eisler Engineering Co., Inc., Newark, N. J.
F. B. Shuster Co., New Haven, Conn.
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Winding
American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
Aetna-Standard Engineering Co., Youngstown, O.
American Insulating Mach'y. Co., Phila., Pa.
Broden Construction Co., Cleveland, O.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.

WHERE TO BUY, Continued

W. A. Schuyler, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Wire Rope
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Tinning
American Insulating Mach'y. Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Wood Screw
National Machinery Exchange (Used), New York, N. Y.

MACHINERY—Wrapping Wire
W. A. Schuyler, New York, N. Y.

MILLS—Tandem Rolling and Edging
Torrington Mfg. Co., The, Torrington. Conn.

NICKEL SILVER AND PHOSPHOR BRONZE—Rod, Wire and Strip
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

PANS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

PAPER—Insulating
E. W. Twitchell, Inc., Phila., Pa.

PATENT ATTORNEYS—
Lancaster, Allwine and Rommel, Washington, D. C.

PICKLING COMPOUNDS
American Chemical Paint Co., Ambler, Pa.

PIPING AND FITTINGS—Acid Resistant
Duriron Co., Inc., The, Dayton, O.
Haveg Corp., Newark, Del.

POTS—Lead Melting
John Robertson Co., Brooklyn, N. Y.

PRESSES—Hydraulic and Mechanical
John Robertson Co., Brooklyn, N. Y.

PRESSES—Lead
John Robertson Co., Brooklyn, N. Y.

PULLERS—Wire
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
John Robertson Co., Brooklyn, N. Y.

REEL AND TENSION STAND—
Fidelity Machine Co., Philadelphia, Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS—Annealing and Stranding
Apco Mossberg Corp., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS—Steel
Apco Mossberg Corp., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS—Takeoff
Apco Mossberg Corp., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.

REELS AND SPOOLS—Shipping and Shop
Apco Mossberg Corp., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS—Vulcanizing and Impregnating
Apco Mossberg Corp., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products, Co., Niles, O.

REELS—Wire Drawing
Apco Mossberg Corp., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products, Co., Niles, O.

REFRACTORIES—High Temperature
Norton Co., Worcester, Mass.

ROD BAKERS—
Morrison Engineering Co., Cleveland, O.

RODS—Wire—Non-Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.
Seymour Mfg. Co., Seymour, Conn.

RODS—Wire—Steel
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

RUST PROOF COMPOUND—
American Lanolin Co., Lawrence, Mass.

SHEET—Steel
Continental Steel Corp., Kokomo, Ind.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

SKIN PROTECTOR—
Magnus Chemical Co., Garwood, N. J.

SOAPS—Industrial and Wire Drawing
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Homer, N. Y.

SPOOLS—Annealing and Wire Drawing
Apco Mossberg Corp., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Chicago, Ill.

SPOOLS—Shipping and Shop
Apco Mossberg Corp., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Chicago, Ill.

SPOOLS—Steel
Apco Mossberg Corp., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

STAMPINGS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

STRIP—Brass and Non Ferrous
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

STRIP—Steel
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.

SWIFTS—Take-off
Apco Mossberg Corp., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TANKS—Pickling
Haveg Corp., Newark, Del.

TANKS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

TREADS—Safety
Norton Co., Worcester, Mass.

TRUCKS—
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

TUBE BENDERS AND FORMERS—
H. J. Ruesch Machine Co., Newark, N. J.

VALVES AND FITTINGS—Acid Proof
Duriron Co., The, Dayton, O.
Haveg Corp., Newark, Del.

VULCANIZERS—
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS—
American Insulating Mach'y. Co., Phila., Pa.

WELDERS—Spot and Butt
Eisler Engineering Co., Newark, N. J.

WIRE—Cold Heading
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE—Electric
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

WIRE—Enameled For Coils
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Manufacturers
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE—Nickel Silver and Phosphor Bronze
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

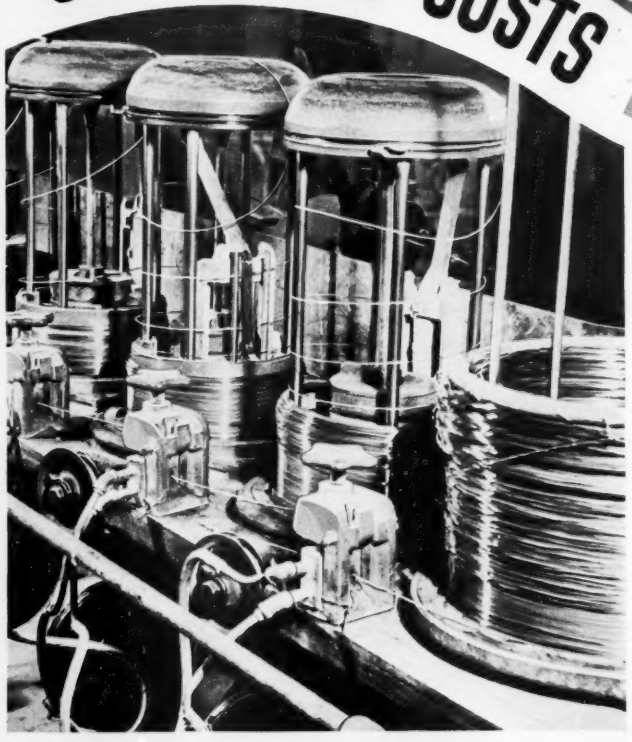
WIRE—Non Ferrous to Specification For Special Purposes
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Spring
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Seymour Mfg. Co., Seymour, Conn.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE—Steel—Also Coppered Steel——Also Galvanized Steel
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE AND STRIP—Zinc
Metal Industry Works, Poland.
Platt Bros. & Co., The, Waterbury, Conn.

THE TREASURER CONSIDERS COSTS



To guard that precarious margin of profit, the treasurer must take the *long view* of wire mill costs. When out-dated equipment can no longer meet the pressure of high powered competition, it becomes too costly to keep. Then it is time for replacement with modern wire drawing machinery— ✓ more productive, ✓ more dependable, ✓ safer, ✓ less expensive to operate and maintain.

All these factors are considered in the design and construction of Morgan Wire Machinery. With their exclusive features and dependable qualities, they ✓ reduce production costs to the minimum— ✓ establish profits on a more predictable basis.

Morgan-Connor Wire Machines; Bull Blocks, Horizontal or Vertical; Galvanizing and Patenting Equipment; and Wire Mill Accessories.

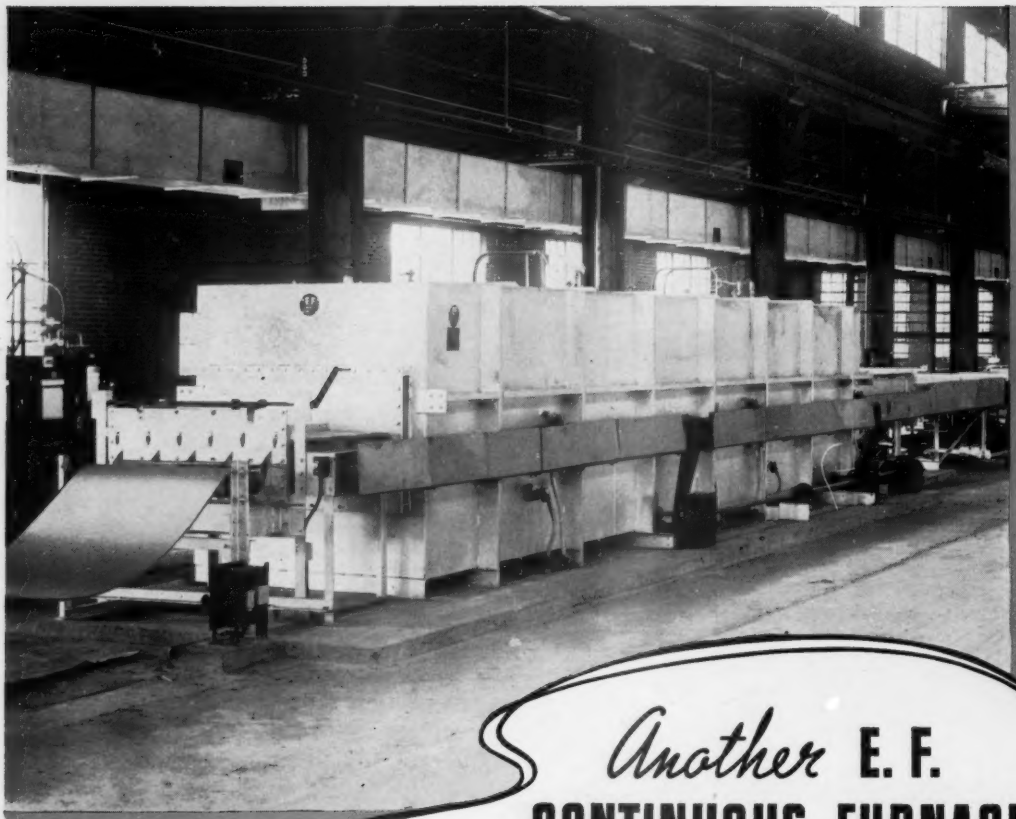
MORGAN CONSTRUCTION COMPANY
WORCESTER, MASSACHUSETTS, U. S. A.

Sole European Representatives: MALMEDIE & CO., Dusseldorf, Germany

W-35

MORGAN WORCESTER ENGINEERS AND MANUFACTURERS

MORGAN *Wire Drawing Machinery*



Another E. F. CONTINUOUS FURNACE *for Bright Annealing Strip*

Cold rolled strip, in any width up to 36", or in any number of narrower parallel strips within the clearance dimensions of 36", can be bright annealed — continuously — in the special atmosphere furnace shown above.

The anneal and finish are absolutely uniform as the material passes through the furnace in strip form and is therefore subject to exactly the same furnace conditions regardless of the width of the strip or the length of the run.

The anneal is secured in a few minutes instead of the usual 24 to 36 hours—permitting quicker deliveries and requiring less material in process.

These furnaces can be built in sizes or batteries to handle any width strip or any tonnage required.

Other EF continuous, controlled atmosphere furnace installations include furnaces for bright annealing various ferrous and non-ferrous products including tubing, wire, sheet, stampings and other products—continuous furnaces for copper brazing, scale-free heat treating and annealing without scale or decarburization, as well as furnaces of various types for normalizing, short cycle malleablizing, nitriding, carburizing, billet heating, heating for forging and other processes.

Submit your furnace problems to EF engineers. With years of experience and hundreds of successful electric and fuel fired furnace installations, we have solved many difficult production furnace problems — experience which may save you considerable on your particular furnace problem.

We build gas fired, oil fired and electric furnaces—for any product, process or production.

THE ELECTRIC FURNACE CO.

ELECTRIC FURNACES — SALEM, OHIO — FUEL FIRED FURNACES